The Adoption of Quality Assurance in e-Health Acquisition for Rural Hospitals in the Eastern Cape Province

by

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THE ADOPTION OF QUALITY ASSURANCE IN E-HEALTH ACQUISITION FOR RURAL HOSPITALS IN THE EASTERN CAPE PROVINCE

by

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ABSTRACT

The evolution of e-health has the potential to assist in the management of scarce resources and the shortage of skills, enhance efficiencies, improve quality and increase work productivity within the healthcare sector. As a result, an increase is seen in e-health solutions developments with the aim to improve healthcare services, hospital information systems, health decision support, telemedicine and other technical systems that have the potential to reduce cost, improve quality, and enhance the accessibility and delivery of healthcare. However, unfortunately their implementation continues to fail. Although there are several reasons for this, in this study a lack of project quality management is viewed as a key contributor to the failure of e-health solutions implementation projects in rural hospitals. This results in neglected aspects of quality assurance (QA), which forms an integral part of project quality management.

The purpose of this study is to develop a Generic Quality Assurance Model (GQAM) for the successful acquisition (i.e. development and implementation) of e-health solutions in rural hospitals in the Eastern Cape Province to enable improved quality of care and service delivery. In order to develop and test this model it was necessary to identify the QA methodologies that are currently used in rural hospitals and to evaluate their strengths and weaknesses, as well as their impact on project success.

The study is divided into four phases; in each phase different study designs were followed. The study used triangulation of qualitative and some elements of quantitative research approaches, in terms of which a case study approach was adopted to answer the research questions. This study did indeed develop a GQAM that can be used to ensure e-health solution success in rural hospitals. Furthermore, to aid in the implementation of this model, a set of QA value chain implementation guidelines were developed, as a framework, to inject the model into typical (SDLC) phases.

Key words: quality, quality assurance, e-health solutions, ICT4D, healthcare, project quality management.

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ABBREVIATIONS

- **DoC:** Department of Communications
- ECDoH: Eastern Cape Department of Health
- **GQAM:** Generic Quality Assurance Model
- ICT: Information And Communication Technology
- ICT4D: Information And Communication Technology For Development
- ISO: International Standards Organization
- IT: Information Technology
- PQM: Project Quality Management
- NDoH: National Department of Health
- **QA:** Quality Assurance
- QMS: Quality Management System
- SDLC: Solution Development Life Cycle
- TQM: Total Quality Management

1.1 BACKGROUND

Information and communication technologies (ICT) appear to be one of the vital core elements in the operation and competitiveness of organisations throughout the world. Many organisations use ICT as "a weapon in the battle to increase productivity, deliver quality products and services, maintain customer loyalty, and make sound decisions" (Shelly, Cashman & Roseblant, 2007).

This benefit of ICT has been adopted by the healthcare sector where ICT solutions are being implemented to enhance quality of care, reduce costs and prevent medical errors. According to Canada (2000), accurate and detailed patient information is critical for healthcare professionals, medical researchers, health administrators, patients, policymakers and families to make informed decisions regarding diverse issues in healthcare. Thus, the adoption of ICT can facilitate the need to share the required information amongst the stakeholders within the healthcare system.

Furthermore, the introduction of ICT has the potential to assist in managing skills shortages and insufficient resources while enhancing efficiencies, lessening workload and boosting work productivity (Kimaro & Nhampossa, 2004). Kimaro and Nhampossa (2004) further state that the lure of this potential is exaggerated by the existing conditions and inefficiencies of the healthcare services in developing countries.

In the recent past, there have been major advances in ICT driven by the increasing need to develop and organise efficient ways of providing healthcare services. Consequently, there have been rapid increases in the adoption of ICT in healthcare, collectively known as "e-health", which promises to have an enormous impact on all healthcare elements. Some of these elements are the delivery of information that communities require to make informed decisions on healthy lifestyle, the facilitation of designs for future medicines, and the shaping of healthcare systems to be more competent and reactive, and to provide home-based care

through mobile healthcare technologies (Europa, 2006). According to Chu (2007), the key drivers for e-health are the quality, safety, effectiveness and efficiency of healthcare services.

Rawabde (2007) maintains that information technology (IT) advancements underpin e-health. These advancements continue to have a positive effect on the healthcare culture (May, Mort & Mair, 2002). The new technology has the potential to present reliable and effective ways of providing patient care, such as using video-conferencing, which have attracted the attention of both healthcare decision and policy makers (Allen, Whitten & Maheu, 2001).

In South Africa, an increase is seen in e-health developments that have the potential to improve healthcare services. These include innovations such as the district health information system (DHIS), OpenMRS, electronic medical records, hospital information systems, public networks, health decision-support and expert systems, telemedicine and community health information systems, and other technical systems that have reduced healthcare costs, improved quality, increased accessibility and enhanced the delivery of healthcare services (ADF, 2001; Braa & Hedberg, 2002:113–127; Seebregts & Singh, 2007).

These e-health developments are viewed as a vehicle that can bridge the digital divide between rural and urban healthcare centres (Ruxwana, Herselman & Conradie, 2010). They promise to facilitate the capability to find solutions for the challenges that the rural healthcare sector is faced with (Ruxwana *et al.*, 2010), and to extensively transform healthcare services delivery and patient care, and introduce solutions that facilitate the management of the healthcare system throughout the world (Louw & Hanmer, 2002).

E-health developments are, however, faced with several challenges that appear to hinder their implementation. Some of these challenges are associated with the legal and regulatory environment, the limitations of the technology and the trust of the patients (Deloitte, 2006). The majority are associated with the failure of IT projects (Mbananga, Madale & Becker, 2002; Heeks, 2002; Braa & Hedberg, 2002; Standish Group, 2004). Over a decade, several scholars have investigated the success and failures of IT projects and they have identified several factors of success (DeLone & McLearn, 2003; Gable, Sedera & Chan, 2008; Standish

Group, 2001) and factors of failure (Brock, Hendriks, Linnel and Smith, 2003; Standish Group, 1994; 2004; Jones, 1998 in Funchall, 2009; Matta and Ashkenas, 2005:3). Interestingly, most of the factors associated to those that can positively effected by appropriate adoption of project quality management, through element of quality assurance. A question worth investigation is whether the adoption of quality assurance models can add value and ensure success of IT projects, especially in the rural context.

This thesis is a research initiative. The aim of this study is to develop a Generic Quality Assurance Model (GQAM) that can be used to add value and ensure the successful acquisition of e-health solutions in rural hospitals in the Eastern Cape Province to improve the quality of care and service delivery. The viewpoint of this study is that the lack of emphasis on quality assurance (QA), as a subset of project quality management when implementing IT solutions, is one of the major contributors to implementation challenges and failure.

1.2 PROBLEM STATEMENT AND PURPOSE

The ICT revolution has greatly affected the healthcare sector by providing solutions that can enhance information access, storage, retrieval and analysis, and the dissemination of accurate patient medical history (Asangansi, Adejoro, Farri & Makinde, 2006). Healthcare services have been enhanced by the involvement of technology and the rapidly increasing ICT innovations in healthcare, referred to as "e-health" (Asangansi *et al.*, 2006). The importance of ICT to the healthcare sector is increasing as organisations develop solutions that attempt to facilitate reductions in the cost of care and improvements in service delivery, quality of care and patient safety. Littlejohns, Wyatt and Garvican (2003) further state that a massive investment has gone into computerising hospital information systems worldwide.

However, the implementation of these e-health solutions essentially occurs in the developed world with a limited scope of implementation in the developing world. As stated by various researchers, this is due to many challenges linked to the digital divide, which compromise the implementation of ICT. These include a lack of infrastructure, services and knowledge,

limited resources, low literacy levels and professional isolation (Herselman & Jacobs, 2003; Olugbara, Ojo, Adigun, Emuoyibofarhe & Xulu, 2006; Uys, 2006; Littlejohns *et al.*, 2003).

Conversely, the lagging implementation may be due to the high failure rate of IT project implementation, as reported in the CHAOS reports of the Standish Group (Standish Group, 1994; Standish Group, 2004). Although there have been some developments in IT projects in recent years, the reported failure rate of IT projects is still distressingly high, especially on larger projects (Standish Group, 2004; Jensen; 2007: 919; London & Hart, 2004). The report reveals that only 29% of IT projects globally are successful, namely they are released on time, within the budgeted costs and conform to the specified requirements (Standish Group, 2004).

South African healthcare ICT initiatives are no exception, although there is limited literature about their success or failure. The few studies conducted on healthcare projects in South Africa note that the projected failure rate is higher than that of developed countries. This may be due to the challenges and limitations that the country is faced with (Mbananga, Madale & Becker, 2002; Heeks, 2002; Braa & Hedberg, 2002). However, Littlejohns *et al.* (2003) maintain that an evaluation, using qualitative and quantitative methods, revealed that the reasons for failure in South African healthcare ICT initiatives were similar to those in other countries.

The status of IT projects can be categorised into the following according to Heeks (2002):

- **Total failure** a project that has never been implemented or in which a new system was implemented but immediately abandoned.
- Partial failure a project in which the most important objectives are not achieved or in which there are considerable undesirable results. In some cases, only part of the initially stated goals were realised. Another type of partial failure that seems to affect developing countries in particular is the problem of sustainability. There are projects that succeed initially but then fail after a year or so.
- Success a project in which most stakeholder groups attain their major goals and do not experience significant undesirable outcomes.

Heeks (2002) and Matthews (2007) further mentions that most information system projects in developing countries fail either totally or partially.

It is, therefore, evident that there continues to be failure in ICT projects and this researchattempts to solve this problem from several critical angles . From the several attempts by researchers to resolve this problem, Brock, Hendriks, Linnel and Smith (2003) state that, after examining the causes of a high failure rate, several key factors are reported as being common major contributors to IT project failure. These authors advocate that these problems should be resolved by giving more attention to the implementation procedures and the management of these initiatives. Other previous research studies have shown that the following, among other factors, are possible contributing factors of IT initiative failure (Standish Group, 1994; 2004; Jones, 1998 in Funchall, 2009):

- Vague project vision;
- Impractical expectations owing to insufficient estimating techniques;
- Lack of reliability in design, development and implementation processes;
- Insufficient project resource policies;
- Employment of technically unskilled staff.

Conversely, other scholars, driven by the continuous confusion about the success of Information system (IS) and their value to organizations, are of the view that there needs to be an understanding about IS success to combat its failures, and they conducted research into IS success measurement models.

According to DeLone and McLean (2003), the measurement of success or effectiveness of IS is critical to understand the value and efficacy of IS management and IS investment. IS success measurement is importent considering the continued failures and that these failures continue to be a key issue cited by organizational executives globally (Irani & Love, 2000; Thatcher & Oliver, 2001). There continues to be little consensus among scholars and experts on how to best measure success.

Some important contributions come from various IS success models developed by scholars such as DeLone and McLean (1992), Shang and Seddon (2002) and Gable *et al.* (2008) who identified that IS success is multi-dimensional. The DeLone and McLean (1992) IS success model, which is the mostcited, classifies the success measure into six dimensions:

- System Quality;
- Information Quality;
- Organizational Impact;
- Individual Impact;
- Satisfaction;
- Use.

Significantly, quality is mentioned as an essential element in all these success models.

However, these models focus on the quality of the product - the solution, and do not particularly address the aspects of quality from the project management context. The DeLone and McLean updated IS success model of 2002, catergorises quality into three dimensions: information quality, systems quality, and service quality (DeLone & McLean, 2002). Clearly these models are focussed on the actual product, while project quality management processes include all the processes and activities of the performing organization that determine the quality policies, objectives, and responsibilities so that the project will satisfy the needs for which it was undertaken (PMBOK, 2004). Project quality management enforce the quality processes of the actual products, which are stated in the IS success models.

Project quality management implements the quality management system (QMS) of the organisation through policy and procedures using continuous process improvement activities which are conducted throughout, as appropriate to each project (PMBOK, 2004). Project Quality Management includes inter-functional processes which include: Quality Planning, Quality Control, and Quality Assurance (QA). There are several studies conducted in the context of project quality management and methods and models have been developed, yet the ICT (IT and IS) projects continue to fail. . In particular, these studies on project quality management, do not carefully address the element of QA and its adoption in the rural

context, thus making this study novel because it further investigates the adoption of QA in the rural hospital context, a task never before attempted.

According to Jones (1998:114), IT project successes and failures result from the fact that the root causes of such successes and failures include technical, cultural and management factors. This implies there are more ways to fail in IT projects than there are to succeed. The capabilities of the IT project management team have a strong impact on the success of a project and poor IT project management practices have been universally noted to cause failed projects (Funchall, 2009).

In concurrence with Jones (1998), Matta and Ashkenas (2005:3) emphasise that IT project failures are often due to traditional methods that ponder on developing recommendations, new technologies and partial solutions rather than on focusing on the end result. As a result, project teams are faced with difficulties when assembling the project pieces. Hence, it is vital to assign skilled resources to IT project activities and deliverables. Van Zyl (2004:209), cited by Funchall (2009), states that the significance of having skilled resources on IT projects can not be ignored and that experienced IT project managers and specialists are crucial in making projects successful.

It is reported in the CHAOS reports of 1994 and 2004 of the Standish Group that the introduction of formal project quality management has increased project success to 29% (Standish Group, 1994; Standish Group, 2004). In support of this, Jones (2004) states that the six most common problems identified when observing failed projects include:

- Poor project planning
- Poor cost estimating;
- poor measurements;
- poor milestone tracking;
- poor change control;
- poor quality control.

These problems can be identified and mitigated through the use of QA as a subset of project quality management. As a result, successful IT projects generally exhibit higher expertise in

these six areas. Remarkably, these six problem areas are related to project management rather than to technical expertise. It is evident that inadequate project quality management, especially the lack of QA, is a contributing factor to the failure of projects.

Furthermore, it is important to note that e-health solutions used in providing healthcare are often both safety and mission critical. Therefore, it is important to ensure that these solutions are of high quality and that the processes used to develop and implement them follow the best QA methodologies and standards. This study maintains that the quality of the systems is subject to the quality of its acquisition and maintenance processes.

This study aims to propose generic QA methods, in the form of a model, to improve the successful acquisitions of e-health solutions in rural hospitals in the Eastern Cape Province to improve the quality of care and service delivery. In this study, solution acquisitions refers to the processes adopted in the design, development and implementation. QA methodologies refer to the adopted processes that ensure quality within the project. These relate to the entire solutions processes, such as the packages that are customised to fit the context, the solutions developed internally and externally, a process that can be used for outsourced solutions. Hence, the following questions are relevant for the purpose of this study.

Main research questions:

What are the components of a generic quality assurance model (GQAM) to assist rural hospitals in the Eastern Cape Province with the successful acquisition of e-health solutions?

The following sub-questions are posed to answer the main question :

- 1. What are the QA methodologies used in e-health acquisition for rural hospitals?
- 2. How do these methodologies aid successful e-health acquisition in these rural hospitals?
- 3. What are the challenges experienced when applying these methodologies in rural hospitals?
- 4. What sensible model can be adopted to overcome these challenges and to improve the quality assurance processes used in e-health acquisitions in rural hospitals?

Therefore, the main objective of this study is to determine the essential components of a QA model and to develop a GQAM that will aid successful implementation of e-health solutions in rural hospitals. The sub-objectives of this study are to:

- Investigate and identify the QA methodologies used in e-health acquisitions for rural hospitals, and to further determine how these adopted QA methodologies are used as compared to available QA methodologies and standards.
- Determine and describe the role in which these adopted methodologies support the successful acquisition of e-health solutions in rural hospitals;
- Identify the challenges experienced when adopting these methodologies, with regards to e-health solution acquisitions in rural hospitals;
- Evaluate and determine the quality levels of the processes used in systems acquisitions in rural hospitals; and to,
- Develop a generic model that can be adopted to overcome the challenges experienced with adopting QA methodologies and to enhance the processes used in systems acquisitions for rural hospitals.

1.3 IMPORTANCE OF THE STUDY

South Africa, in common with most developing countries, is faced with several challenges and the government and supporting stakeholders are continuously probing strategic ways to

alleviate poverty and promote socioeconomic developments. Better healthcare has proved to be the focus of and the central point of departure for poverty alleviation strategies. However, the majority of South Africans live in the rural areas, and the hospitals in these areas are faced with several challenges which add to the dilemmas. These challenges range from a lack of specialised skills, a lack of access to information and services owing to the remoteness of the regions, increased medical errors and duplication owing to the information systems used, and the challenge of being the only hospital in the whole village which hinders timely healthcare assistance for the disadvantaged communities who are so prone to serious disease due to unhealthy environments and lifestyle.

E-health has the potential to overcome many of the challenges faced by rural hospitals. However, there is a high level of failure in IT project implementation. As discussed above (cf section 2), most of these failures are linked to inappropriate project management processes that are adopted when implementing these solutions and especially, to the lack of QA as a subset of the project quality management domain.

In the available literature there has been limited work published on the evaluation of e-health solutions implemented in rural areas, especially in developing countries in Africa. Within the available limited scope, none of the published work reports on issues relating to QA as a subset of project quality management for systems acquisitions. Although project quality management is noted internationally as one of the key factors that contribute to IT project success. There is limited focus on QA as an integral part of project success and little or nothing related to the context of e-health solution implementations globally.

This study details issues relating to the adoption of QA methodologies in e-health acquisition projects in rural hospitals in South Africa. This is achieved by considering the challenges and successes of the existing methods; the underlying factors relating to the failures in e-health solutions in rural areas associated with project quality management and the role of QA in aiding successful e-health acquisition in rural areas. The different complexities that differentiate the context of rural areas from that of urban areas and the developed world are considered and a general quality assurance model (GQAM) to foster QA in e-health

acquisition projects in rural areas was developed. The GQAM assists in the adoption of quality standards in e-health projects in rural areas, and provides ways to overcome the challenges related to project management that were identified during the study. In addition, it assists in ensuring the successful implementation of e-health solutions, as well as facilitating and promoting continuous improvement within the project process, as well as after the project implementation, through project evaluations and knowledge-base creation.

This study provides value chain implementation guidelines as a framework for GQAM implementations within the typical traditional Solution Development Life Cycle SDLC phases to aid the understanding of the GQAM artefacts and to guide its implementation in any solution projects acquired in rural areas. This framework provides guidelines on activities and deliverables that have to be considered to ensure that QA is not compromised within and after the project lifecycle, irrespective of the methodologies used.

Therefore, the main contributions of this study are the GQAM and its respective framework for implementations for e-health solutions in rural hospitals whilst considering the unique complexities and challenges they face. In addition, there is limited literature, if any, on e-health solutions in developing countries – especially rural areas in Africa – relating to QA. Thus, with its proposed models and frameworks as starting points for resolving the challenges experienced, this study provides new knowledge on the research area.

1.4 DEFINITIONS OF TERMS

The following are the key terms used in this study:

- Acquisition: this refers to the project management process and activities carried out to develop, construct, implement and operate the e-health solutions, which includes both packaged and developed solutions. Acquisition excludes that process relating to procurement, financial management and logistics.
- **E-Health:** This is an emerging field at the intersection of medical informatics, public health and business and refers to health services and information delivered or

enhanced through the Internet and related technologies. In a broader sense, the term characterises, according to Eysenbach (2001) as "not only a technical development, but also a state of mind, a way of thinking, an attitude, and a commitment to networked, global thinking to improve healthcare locally, regionally and worldwide by using information and communication technology".

- Generic Quality Assurance Model: This is a model that fosters quality through project quality management within the process of acquiring a solution. This model is said to be generic as it can be applied in any project adopted for the given context, irrespective of the solution development methods adopted.
- Healthcare Professionals: This refers to those persons who are involved in the healthcare service process to cure the patientthis involves nurses, doctors, clinicians, radiographers, dermatologists, and so forth.
- Project Team: This refers to all those who are involved as members in the process of implementing the solution.
- Quality: This is the totality of characteristics of an entity that bear on its ability to satisfy both stated and implied needs (ISO8042:1994). This means meeting user expectations by conforming to the requirements and producing a product that is fit for use.
- Quality Assurance (QA): ISO defines QA as all the planned and systematic activities implemented within the quality system and demonstrated as needed to provide adequate confidence that an entity will fulfil its requirements for quality (Gryna *et al.*, 2007: 519). Many QA activities provide protection against quality problems by the use of early warnings of possible problems. QA is concerned with the consistency, readability, usability, maintainability, reliability and other attributes of the completed system and the work products produced throughout the project life cycle.

- QA Methodologies: This refers to the adopted guidelines or methods followed in executing QA. These can be standards, models, defined methodology, policies or procedures followed in e-health solutions projects.
- Quality Management: This is the process that ensures that all the project activities necessary to design, plan and implement a project are effective and efficient with respect to the purpose of the objective and its performance (PM4DEV, 2008).
- Project Quality Management: This includes all the processes and activities of the performing organization that determine quality policies, objectives, and responsibilities which ensure that the project will satisfy the needs for which it was undertaken (PMBOK, 2004). The project quality management enforces the quality processes of the actual products, which are stated by IS success models. Project quality management implements the quality management system (QMS) of the organisation through policy and procedures with continuous process improvement activities conducted throughout, as appropriate to each project (PMBOK, 2004).
- Solution/System Quality Management: This refers to adoption of standards and measures to ensure the building of software/solution products that meet the customer requirements (design, interface, business requirements, functional requirements etc) and are ready to deliver. Solution or system quality includes characteristics such as reliability, functionality, efficiency, maintainability, and portability. These are commonly ensured through Software\Solution Quality Assurance (SQA).

1.5 RESEARCH METHODOLOGY

Leedy and Ormrod (2001:3) refer to research as a systematic process of gathering and analysing data to improve the understanding of the phenomenon of interest.

Research can either be quantitative or qualitative in nature as highlighted below:

- Qualitative research is a multi-method approach to the study of social interactions in natural settings. It includes elicitation and analysis of empirical data from various sources such as first-person accounts, life histories, visual records, semi-structured and open-ended interviews, informal and formal observations, biographical, and autobiographical materials (Eckert, 1998).
- *Quantitative research* is structured, rational, measured and broad. Surveys and questionnaires for this type of research tend to be used by most researchers (Coombes, 2001: 29–31).

This study follows a phenomenological research philosophy supported by a social constructivism approach consisting of four phases. A case-study approach was followed to answer the research question and to develop the models. Both qualitative and quantitative instruments were used to collect data for answering the research questions and to promote the reliability and validity of data. Hofstee (2008) supports this course of action and states that it is appropriate to use a combination of both in a research study.

The study research process was executed in a series of four phases: In the first phase,, literature reviews were conducted and sample selections were made; In the second phase, the study data were collected using a questionnaire, interviews, observations, document analysis and expert reviews as the data collection instruments; In the third phase, the collected data and the literature review were used to develop a draft model for QA; and, in the fourth phase, through a series of review cycles, the model was reviewed and adapted until the final model was produced by means of expert reviews and then presented. Within the fourth phase, the value chain implementation guidelines for the GQAM were developed and reviewed through the series of cycles; finally, the study documentation was produced. Figure 1.1 presents these study phases:





The research design is discussed in detail in chapter 4.

1.6 DELINEATIONS

The study was carried out in rural hospitals in the Eastern Cape Province of South Africa. Project management only, related to QA processes, was considered for answering the study questions. In addition, local experts in the field of QA, e-health, solution design and project management were used as reviewers of the findings and the developed model based on their experiences in industry and academia. The findings obtained and the study recommendations were presented to the Eastern Cape Department of Health e-health team and management for verification.

1.7 LIMITATIONS

The following are the limitations of this study:

- The GQAM was not tested in an operational setting, although it was verified for applicability.
- The model was reviewed only by specific experts from South Africa and those who specialise in e-health solutions, project management and QA.

1.8 ETHICAL CONSIDERATIONS

Cooper and Schindler (2003: 16) maintain that a research design should prevent mental or physical harm to participants and should make data integrity a first priority. Ethical issues in research reflect important moral concerns about the practice of responsible behaviour in society.

According to Cooper and Schindler (2003: 120), ethics are norms or standards of behaviours that guide moral choices about personal behaviour and interpersonal relationships with others. The purpose of ethics in research is to ensure that no one is harmed or suffers adverse consequences as a result of research activities. Unethical activities include pervasive and violating non-disclosure agreements, breaking respondent confidentiality, misrepresenting results, deceiving people, invoicing irregularities, avoiding legal liability, and others (Cooper & Schindler, 2003). This research has ensured that none of these unethical issues occurred.

Olivier (2004: 23) states that research which involves human participants should be reviewed by an ethics committee to determine whether the research should be allowed to continue. This research protocol was reviewed and approved by the Nelson Mandela Metropolitan University senate (cf Appendix B) and by the Eastern Cape Provincial Government Health Department (cf Appendix C). Therefore, the research would not have been allowed to continue if there had been any ethical issues involved. In addition, all participants were asked to sign an informed consent form before they were interviewed (Appendix D). All information will be kept confidential by the institution and the researcher for two years.

1.9 CHAPTER OUTLINE

The study is divided into nine chapters that relate to the four phases of this study (cf figure 1-1). Chapter 1, the introduction, provides an overview of the research including its scope and limitations and the research questions. In chapter 2, an overview of ICT4D and its related solutions and their impact in South Africa is provided. Chapter 3 is a contextualisation of the study in which background is given on Quality notions, standards, models and methodologies with a focus on aspects of QA as its subset to enable a conceptualisation of the research. Chapter 4 contains descriptions of the research methods and designs used during the research, including the research approach, the data-gathering instruments and the sample size. The three research questions are addressed in chapters 5, 6 and 7 respectively. Chapter 6 consists of a discussion of the proposed GQAM. In chapter 8 the applicability of the GQAM is described and presented in the form of developed QA value chain implementation guidelines.

In chapter 9, the contribution of this thesis from the perspective of the research questions is discussed. The chapter concludes with a summary of the findings of this research, including recommendations to the participating hospitals, an overview of its contribution and, lastly, discusses avenues for possible future research that were identified during the study. The chapter layout is illustrated graphically in Figure 1-2, below.



Figure 1-2: Chapter outline

1.10 CONCLUSION

It is evident that e-health solutions have the potential to supply solutions to several of the challenges faced by healthcare services, especially those in the rural areas where the digital divide and shortages of skills mainly exist. It has been found that the e-health solutions

promise to enhance the quality of service delivery, reduce costs, improve decision making, and reduce medical errors and duplication. Such solutions include telemedicine, electronic patient records and hospital information systems. However, there is evidence that the implementation of these solutions in rural hospitals continues to fail. Accordingly, the purpose of this study is to develop a GQAM for the successful acquisition (i.e. development and implementation) of e-health solutions in rural hospitals in the Eastern Cape Province to improve the quality of care and service delivery.

2 ICT FOR DEVELOPMENT: SUCCESS AND FAILURE

2.1 INTRODUCTION

As mentioned in the introductory chapter, ICTs play an important role and are one of the core factors in the survival of an organisation. Many organisations, government departments and private companies are taking the advantages that ICT solutions can provide in order to improve their service delivery and quality of life, and the competitive advantage of their business. Although the potential of ICT has been realised by most of the developed world, its promised potential to provide solutions to many of the problems experienced by the developing countries have yet to be experienced. Thus, the implementation and use of ICT lags behind the First World in most developing countries.

In this chapter, the role of ICT in development, notions of ICT for development, ICT for healthcare and e-health solutions are discussed. The chapter provides an overview of ICT project failure. The chapter begins with the discussion on the roles played by ICT in development.

2.2 THE ROLE OF ICT IN DEVELOPMENT

McNamara (2008) asserts that ICT potentials have proved to be crucial for business and success. While viewed as an essential element for poverty reduction in the developing world, the evolution of ICT has gained momentum and they are increasingly used for entertainment in the developed world (McNamara, 2008). Thompson (2008) points out that ICT is viewed as a critical and essential enabler for future developments in any country and is critical for the developing world. This is because ICT has the potential to achieve four of the five developmental indicators of Sen (1999: xii), namely, the potential to facilitate economic opportunities, political freedoms, social facilities and transparency guarantees, and the capability to develop "knowledge societies", which are viewed as a vital accelerator for development (UNESCO, 2005).

In the literature, several studies assert that the key contributors to continuous economic growth and the essential factors for the development of a country are technology and human capital (Jacobs & Herselman, 2005; Thompson, 2008; Hosman, Fife & Armey, 2008). However, there are limited sources that have addressed ICT-related issues within the context of developing countries and, according to Hosman et al. (2008), most of these studies have reported negative or mixed findings concerning economic growth or returns on capital in developing countries. This is supported by the findings of Dewan and Kraemer (2000), Pohjola (2001), and Seo and Lee (2006). However, a recent study conducted by Hosman et al. (2008) reveals positive economic returns on ICT investment for developing countries. This concurs with findings reported in the literature on the positive ICT returns on productivity, which have been a reality for the developed world and that have now become evident in the developing world (Papaioannou & Dimelis, 2007; De Silva & Zainudeen, 2007: 2; Thompson, 2008; Jensen, 2007; Hosman et al., 2008; Heeks, 2002). This is further affirmed by COFISA reports that demonstrate the positive impacts of ICT in rural development where local economy, human capacity and knowledge levels have been developed by the introduction of the different ICT (COFISA, 2008).

Furthermore, there is some empirical evidence that small businesses which have adopted ICT enjoy enhanced profitability and growth (Thompson, 2008; Raymond, Bergeron & Blili, 2005; Qiang, Clarke & Halewood, 2006; Southwood, 2004). In addition, the evolution and rapid developments of mobile phones and their adoption in developing countries have shown a positive and significant effect on their economic growth (Waverman, Meschi & Fuss, 2005).

However, ICT is not a panacea for all problems and thus, should not be considered solely as a driver of growth and development, but as a support function that enables growth and development (Thompson, 2008).

Although economic growth has been the focus of development in several countries recently, there has been a shift in focus towards poverty alleviation. Many researchers, such as Thompson (2008), Pade, Mallinson and Sewry (2006), McNamara (2008), and Heeks (2009), emphasise the fact that poverty alleviation and the empowering of human beings towards an

improved life style must be the essential objective of ICT projects in developing countries. However, the challenge for decision makers and those involved in these projects is to understand the best method to adopt to implement the relevant technologies in the quest for the main ICT project objectives (Hosman *et al.*, 2008).

Heeks (2009) underlines the importance of poverty alleviation and advocates profound interest into poverty problems by developed countries, because he maintains that the current difficulties of the poor can tomorrow, through migration, terrorism, and disease epidemics can become the dilemma of governments in the developed countries. By contrast, as the poor become wealthier , they spend more on the products offered by the industrialised countries, thus, poverty alleviation efforts result in benefits for everyone (Heeks, 2009). Hence, ICT implementations in developing countries have become a critical approach to global improvement for sustaining poverty reduction strategies (Jauering, 2003: 1).

The COFISA (2008) reports coincide with other research findings about the positive impact of ICT for development and further asserts that the introduction of ICT in rural areas can be described as a platform to facilitate the following:

- The alleviation of poverty in disadvantaged areas;
- The growth of local economies in rural areas ;
- The attainment of fundamental standards of health, safety and other developmental infrastructure and services in rural areas ;
- The encouragement and empowerment of rural people to invest their communities;
- Cultural regeneration, including the development and integration of indigenous knowledge systems into a rural community's "ways of doing and learning";
- The long-term sustainability of livelihoods and improvements in quality of life.

It is estimated that about three quarters of the poor of the world, approximately 900 million people, reside in rural communities, relying on agriculture and other livelihood activities;. These areas form the main target for development (Bage, 2004; Pade *et al.*, 2006). According to Mwabu and Thorbecke (2001) and supported by Pade *et al.* (2006), rural areas are compromised by intense poverty levels linked to challenges such as poor infrastructure,

unsustainable population growth, insufficient agricultural productivity, environmental degradation, limited access to markets and market information, low levels of investment in people, ethnic and tribal conflicts, the HIV/AIDS pandemic and high disease burdens, inappropriate economic policies and the adverse effects of globalisation. Heeks (2009) further states that the poor are always most affected by the problems that a country faces, ranging from climate change, conflict and terror and disease, to resource depletionwith the poor in the developing world suffering the most.

When ICTs are appropriately adopted, they have the potential to enhance the lives of poor communities in underprivileged areas and increase revenue prospects which can conquer the persistent poverty (McNamara, 2008). When ICTs are implemented appropriately they have the potential to reduce poverty by enhancing access to information, and education, health, government and financial services for disadvantaged communities (Cecchini & Scott, 2003).

According to Pade, Mallinson and Sewry (2008), the critical factors aiding rural advancement practices, aimed at alleviating poverty, are information and knowledge. They further maintain that rural communities are constrained in their development process when deprived of information and knowledge (Pade *et al.*, 2008), because they are deprived of the opportunity to participate in the "wider" society, be it at a local, national or global level (Accascina, 2000; Chapman & Slaymaker, 2002; CIDA, 2003; Meyer, 2002; NetTel, 2005; Pade *et al.*, 2008).

It is evident in the COFISA (2008) report that ICT refers to both recent and aged technologies that aid the processing and transfer of information across space and time (COFISA, 2008). Therefore, ICTs becomes critical to the rural development process by facilitating information and knowledge sharing between rural communities and more developed regions (Heeks, 2002; Pade *et al.*, 2008).

There has been extensive investment in ICT for development projects, funded by the private sector, governments, development donors and agencies, yet ICT has not benefited the rural communities who suffer from persistent poverty (McNamara, 2008; Dávalos, French, Burdick & Simmons, 2009). In response to this, notions of ICT-for-Development (ICT4D) have

emerged. The following section discusses its inception, which is aimed at bridging this gap and accelerating the use of ICT in developing countries, especially in rural areas.

2.3 ICT-FOR- DEVELOPMENT (ICT4D) INCEPTION

In developing countries, ICT have the potential to overcome poverty and promote economic and social development. This view, according to McNamara (2003), is led by the increasing creativity in technologies, applications and business processes driven by the growth of global information and communication networks and by advances in computing, and the broader social impacts of these new technologies.

According to Grimshaw and Talyarkhan (2005), the concept of "development" has been evolving since its origins after the Second World War. The international development community focus has shifted over the years, from a focus on economic development and growth to one on poverty and to acknowledging the various contributory factors to poverty, such as a limited access to markets and services or vulnerability to shocks.

It has been realised through this shift, as shown in several studies, that the most effective way to alleviate poverty is through effective acquisition and propagation of information and knowledge. Consequently, there is a consensus that ICT is a key role player in development in terms of facilitating such information and knowledge needs by, for example, connecting people to more accurate and current information, equipping them with new skills or connecting them to an international market (Grimshaw & Talyarkhan, 2005; Matthews, 2007; Heeks, 2002; Pade *et al.*, 2006; COFISA, 2008).

As the important role that ICT can play in supporting development became obvious, so did the importance of their use. As a result, several international initiatives have been established to harness ICT for development on a global scale (Grimshaw & Talyarkhan, 2005). These include the Global Knowledge Partnership (founded in 1997), the DOT-Force (created in 2000) and the UN ICT Task Force (created in 2001). Chapman and Slaymaker (2002)
maintain that the aim of these projects is to develop cooperation between the community, the public and the private sectors to harness ICT for development.

According to Grimshaw and Talyarkhan (2005), the term "ICTs for development" includes a variety of diverse application of ICT for health, e-governance, agriculture, advocacy and others. Heeks (2009) states that since the first digital computer put to use in a developing country, was installed in Kolkata in 1956 at the Indian Institute of Statistics for scientific calculation work, computing for development focused on the administrative functions of the public sector in developing countries. During the 1980s, multi-nationals and other organisations came to the fore and viewed IT as a tool for delivering economic growth in the private sector.

The role of ICT in national development is argued to depend on how ICT is viewed. Punyabukkana, Thanawastien and Jirachiefpattana (2008) assert that, in this era of ICT, those who can access information have competitive advantages over others who cannot. Currently, the use of ICT for international development is moving into its next phase. This will require new technologies, new approaches to innovation, new intellectual integration and, above all, a new view of the poor (Heeks, 2009). In response to this, researchers, bodies, organisations and other involved parties are constantly creating innovative initiatives and strategies to disseminate ICT for development. Accordingly ICT4D evolved to meet these needs and is discussed next.

2.3.1 ICT4D evolution

According to Heeks (2009), the inception of the Internet and the Millennium Development Goals (MDGs), which happened in the 1990s, gave birth to what might recognisably be called ICT4D 1.0.. It has the aim of diffusing ICTs for development. Owing to the short time span and the rush to deliver solutions, ICT4D 1.0 produced models such as the rural tele-cottage or tele-center, which can be installed quickly; provide tangible evidence of achievement; deliver information, communication and services to poor communities. These provide sales for the ICT companies that were partners in most ICT4D forums (Heeks, 2009). Although the aim of

ICT4D 1.0 was not solely restricted to tele-center projects, they did provide the model for this period (Heeks, 2009). However, these efforts often resulted in failure, restriction and anecdote, as the model was too costly to be sustainable or scalable.

This has led to the development of a second model which learnt from the lessons and challenges of the previous version. ICT4D 2.0 is still in its early stages and the development actors are confronted with the key technical question of how to deliver the Internet to the remaining billions of people who lack such access (Heeks, 2009). It is aimed at understanding and strengthening development through available and accessible ICT in rural areas, such as the use of mobile telephony, which has gained momentum and is still the fastest growing solution to have penetrated a broad-spectrum of the rural communities, especially in developing countries.

2.3.1.1 ICT4D in South Africa

South Africa has a population of about 48 million people (Health Systems Trust, 2008), with 46% residing in rural areas. The country comprises nine provinces and has 11 official languages. It survives on its natural resources and is reported to have one of the largest and most developed economies in Africa, with a GDP of US\$218 billion (Mars & Seebregts, 2008). However, the country is faced with many challenges related to poverty, unemployment and healthcare. The country has a reported official unemployment rate of 23% (SouthAfrica.info, 2008; Mars & Seebregts, 2008), approximately 50% of its people live below the poverty datum line and about 10.7% live on less than US\$1 (purchasing power parity) per day (WHO, 2008; Mars & Seebregts, 2008).

As stated previously, several studies on development have highlighted the fact that the most effective way to alleviate poverty is through the effective acquisition and dissemination of knowledge (McNamara, 2008; Grimshaw & Talyarkhan, 2005; Canada, 2000; Chetley, 2006). Therefore, information and development services form part of the critical factors for the improvement of the lives of the majority of the South African population who are classified as poor (McNamara, 2008; Grimshaw & Talyarkhan, 2005). Grimshaw and Talyarkhan (2005)

further maintain that the ability of the country to use information and the evolving ICT effectively are deciding factors in the progress and prosperity of the country within the new global knowledge-based economy.

In response to the need to harness ICTs for development, several bodies and government departments in South Africa have started to develop and implement ICT solutions. The aim of the government is to ensure the active participation of citizens in improving their lives by providing the public with development communication and information. The following are some of ICT-for-development projects that have been implemented in South Africa, with varying objectives for development:

2.3.1.1.1 Public information terminals (PITs)

The PITs project was launched in 1998 as a joint project between the Department of Communications and the South African Post Office. It is aimed at bridging the digital divide by providing online information for needy communities and by providing a platform for e-commerce with a cost-effective and easy-to-use functionality. According to Coleman (2007), the ultimate purpose of PITs is to build a communication infrastructure that will enable public access government information and services. This project aims to empower the public by providing electronic access to information and communication via electronic mail.

According to Coleman (2007), the motivation for the PIT initiative was in pursuit of the mission statement of the Department of Communication which states: "to strive towards a universal service to enable ordinary people to have access, not traditional media, but also the convenience of Information Technology" (DoC, 2003).

According to McNamara (2008), PITs will afford needy communities with the benefits of information technology, e-government and e-commerce access, which almost everyone can obtain at a lower cost. PITs offer five basic categories of services (DoE, 2003).:

1. Government information and forms retrieval;

- 2. E-mail services,
- 3. Internet browsing; a business section;
- 4. Educational services;
- 5. SMS

A PIT is a computer system designed in the form of a booth. It offers the community the opportunity to access online information easily, such as government information, government forms, job opportunities, education, and health (McNamara, 2008). Since this system is based in post office branches, staff members at the post office branches are trained in the use of the system to help to provide services to those users who may need them.

To ensure sustainability and the greater effectiveness of the system, businesses are encouraged to use them to advertise their products or services to the users. According to McNamara (2008), local municipalities are urged to bring in a link to their systems, because this might add value to the communities they are serving.

The PITs initiative is non-profitdriven and therefore, all the services offered are free, except for access to the Internet, for can be purchased using an access voucher. The income generated from the voucher sales for Internet access is used for maintenance and to support the system.

Although PIT is providing the public with direct, easy and convenient access to online information, which bridges the digital divide, the majority of rural communities are not benefiting because most of the Post Office branches are based in cities and the village branches have not yet had PITs installed. Other challenges faced by PITs include a lack of awareness of PITs services, a lack of computer skills and confidence, and a fear of technology. In addition, there are findings that highlight an overload of information on PITs, the use of inconvenient language, and their slow response (Coleman, 2007).

Another promising ICT for development project in South Africa is the e-schools cyberlabs.

2.3.1.1.2 E-schools cyberlabs

The e-schools cyberlabs project aims to bridge the digital divide and develop underprivileged areas, particularly rural, semi-urban and underdeveloped townships, by introducing ICT services and training in the form of school-based labs for children and training for teachers in basic computing (Summit Communication, 2008; McNamara, 2008). According to McNamara (2008), training programmes focus on the following four areas: promoting human resources development in ICT software; providing a managed facility that enables students to understand and utilise the Internet and related network and software technologies; educating students in the use of opportunities presented by the internet; and providing universal access for students under controlled circumstances within a regulated environment.

In an interview conducted by Summit Communications (2008), Sam Gulube, the Chief Executive Officer (CEO) of the Universal Service Agency, which is one of the key players in this project, states the following that in terms of this project teachers were trained in ICT, on how to use the computers, on how to develop digital syllabi and on how to actually use them in teaching the students. He asserts that, in 2008, about 500 teachers were trained across South Africa in preparation for the 100 cyberlabs and that this project is, at the time of writing, in its completion phase and will be deploying 100 cyberlabs in underserviced areas.

This solution promises to have a great impact in developing the underprivileged through ICT services. However, rural communities are faced with several challenges, such as electricity shortages, lack of infrastructure, and so on that hinder the implementation of such solutions. This project will have to deal with these issues before any of the e-school cyberlabs can be deployed.

The provision of Internet access to communities has been the fastest-growing ICT4D initiative and has had a great impact on developed countries. In South Africa, Multi Purpose Community Centres (MPCCs) initiatives have been introduced to respond to this call and one of the successful implementation is discussed next.

2.3.1.1.3 Multi-Purpose Community Centres (MPCCs)

According to Jacobs (2005), MPCCs are viewed as tools for bringing the benefits and potentials of ICT to regions that have been suffering due to their remoteness and lack of connectivity to the global information society. Often, these community centres are established within target communities in their entirety, providing Internet access and services like e-mail, telephony, education, and library and even postal services to large parts of the community (UNCTAD, 2003). Consequently, these MPCCs attempt to advance access to a broad range of ICT to narrow the "digital divide" (Jacobs, 2005).

South Africa forms part of the developing countries, with most of its people living in rural areas. MPCCs were initially established to present government information, products and services directly to the community and to train and add ICT skills, for instance in the use of the Internet and other technologies, which could be useful in local development programmes. According to McNamara (2008), MPCCs should serve as a base for local, provincial and national government and other service providers and should increase accessibility for local communities to government information and services, thereby improving communication between government and the people.

There are several success stories regarding this MPCCs initiative and while this solution has penetrated some rural communities it has not reached many rural communities due to the challenges already discussed. In addition to these general challenges that face these rural community projects, the deployment of MPCCs is faced with challenges such as sustainability, maintainability, high operational costs, limited capacity and skills.

When ICT are implemented and their benefits are realised, further innovations and creativity with other ICT that could achieve certain goals are continuously implemented. This has been evident in South Africa, as the success of some ICT has resulted in other attempts to take advantage of this technology. This has been evidence by the introduction of another ICT4D initiative, which is discussed next.

2.3.1.1.4 Knysna Municipal Uni-Fi project

According to McNamara (2008), over the past few years, the ICT industry has witnessed dramatic changes, for example, mobile providers offering data services, certain Internet service providers offering television services over the Internet and some metropolitan councils are looking to provide telecoms services to residents. Several municipalities in South Africa are currently attempting to broaden Internet access for their citizens using fibre optics, the electricity grid or wireless connections.

Knysna Municipality, the first South African town to provide Internet access to its 50,000 citizens, decided to use go the wireless route (the Uni-Fi project), closely followed by Tshwane Municipality (McNamara, 2008). The COFISA (2008) states that the "Uni-Fi Knysna has been designed and implemented in such a way that there is no differentiation between the rich and the poor – the same costs and quality of service apply to all".

The key objectives of Uni-Fi Knysna are to provide wireless (Wi-Fi) coverage for the entire municipal area, including the municipal offices, libraries and schools; to provide public hotspots for public Internet access around Knysna, including formal and informal areas and municipal sites; to provide toll-free public phones in informal settlements to allow free telephonic access to the municipality; to provide toll-free local VoIP telephonic access in informal areas via public hotspots; and to connect all municipal sites to the Knysna Municipality data-centre (COFISA, 2008).

According to McNamara (2008), the Uni-Fi Knysna project intends to extend wireless communication across the municipal area to provide free or cheap Internet access to all citizens and re-invest money normally spent on broadband connections into the local economy. The objective of this initiative is to promote local economic development by improving communications for the business community of Knysna, especially black economic empowerment (BEE) businesses, while boosting tourism which is one of the major industries of the town. This will be achieved by extending the service to municipal buildings to reduce costs (McNamara, 2008).

Currently, around 90% of the coastal town and its surrounding areas, up to 40 km away, are covered by Wi-Fi. Consequently, business districts, the main tourist areas, black-owned businesses in informal settlements and the major routes are covered (McNamara, 2008). This coverage coupled with innovative service offerings has already had a significant impact on telecoms services in the region (COFISA, 2008; McNamara, 2008).

In South Africa, there are other several ICT4D projects that have been initiated to alleviate poverty and increase economic growth for rural communities. These include projects such as *Dwesa e-Commerce Platform* in the Eastern Cape Province, *Infopreneurs* and *Wizzit cell phone banking*, which are nationally deployed, and many more. However, most of these solutions have not reached of the majority of the rural areas owing to the challenges encountered ranging from lack of infrastructure to limited capital.

Rural communities, as discussed, suffer from many challenges resulting from poverty, healthcare being the most important. ICT innovations promise to improve healthcare services and the quality of life of rural communities which is important for every country, especially a developing country in which the majority of the population are located in rural areas. The section below introduces the adoption of ICT in healthcare, referred to as e-health.

2.4 ICT FOR HEALTHCARE (e-Health)

The role of ICT can no longer be ignored in the healthcare industry (Bernstein, McCreless & Cote, 2007). In fact, for the healthcare industry to maintain and improve both clinical and business operations, it has to depend on ICT (Clark, 2007).

According to Chetley (2006), the crucial elements in development and poverty reduction are to improve the health of individuals and communities, and to strengthen the healthcare system, disease detection and prevention. Although the delivery and management of health services for deprived communities and regions in developing countries is a complex task, according to Braa and Hedberg (2002). It is important to strengthen information management practices at these levels so they can potentially improve both the coverage and quality of primary healthcare service delivery. Ruxwana (2009) and Ouma and Herselman (2008) promote the adoption of ICTs, because they have the potential to impact on almost every aspect of the health sector. Furthermore, the essential processes in public health, such as communication and information management processes, are facilitated or limited by the available ICT (Chetley, 2006; Ruxwana *et al.*, 2010).

According to the WHO (2004), this is not new to the healthcare sector which has relied on technologies for a long time. These technologies form the backbone of the services to prevent, diagnose and treat illness and disease. ICT are one category of the several available technologies that may be used to support healthcare. Daly (2003) asserts that ICT can be powerful tools for those working to improve health, particularly when they operate according to the right policies, organisation, resources and institutions.

Effective communication and accurate information are pivotal elements in public health practices. The appropriate use of ICT can serve as solutions to these needs, because they can increase the quality of and access to both information and communication. ICT can support health communication in other areas, such as patient communication and education; decision and social support; health promotion; knowledge transfer; and the delivery of services (Suggs, 2006).

The healthcare sector has become aware of the benefits of ICT and, as a result, has adopted several ICT solutions to improve the quality of care, reduce costs and prevent medical errors. According to Canada (2000), physicians and other healthcare professionals, patients, families, medical researchers, health administrators and policymakers rely on accurate and detailed patient information to make decisions concerning diverse issues in healthcare. In such situations the use of ICT can be exploited to share the required information among stakeholders and facilitate information-sharing in the healthcare system (Canada, 2000; Chetley, 2006; Suggs, 2006).

Furthermore, the introduction of ICT has the potential to assist in managing scarce resources, increase efficiencies, reduce workload and increase work productivity. Rawabde (2007) avers that the development of ICT underpins the new field in healthcare practice, termed "e-health". These new developments in ICT will have a major impact on the organisation and experience of healthcare (May *et al.*, 2002). The possibilities that these new technologies present to healthcare systems, practitioners and patients are significant and "linking" patients and clinicians in new ways, such as using video-conferencing, has proved attractive to policymakers (Allen *et al.*, 2001).

Therefore, it is evident that ICT have the potential to improve services, especially in the healthcare sector through e-health initiatives and they have become important for developing countries to consider due to their shortcomings in service delivery. In order to understand the roles of ICT in healthcare services it is important to understand the meaning of the term "e-health". This is discussed below.

2.4.1 Definition of e-health

According to Eysenbach (2001), e-health is an emerging field in the intersection of medical informatics, public health and business. It refers to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterises not only a "technical development, but also a state of mind, a way of thinking, an attitude, and a commitment for networked, global thinking to improve healthcare locally, regionally and worldwide by using information and communication technology".

The PNC (2006) defines e-health as the combined utilisation of electronic communication and information technology to generate, transmit, store and retrieve digital data for clinical, educational and administrative purposes. The purpose of e-health is to contribute to the improvement of the health status of the people of South Africa through the optimal use of ICT.

According to Abard News (2005: 1), e-health may be viewed as health services and health information accessed through the Internet and related ICT technologies. It may include everything from health information based on Internet resources to medical decision-support

systems designed to assist clinical assessment. It involves access technologies connecting remote patients and interconnecting health professionals to each other and to their patients. E-health focuses on the use of ICT to enable health programmes or systems through information, to enhance healthcare service delivery, and to enhance the health of its recipients and its human environment (Uys, 2006).

Ruxwana (2009) defines e-health as the use of ICT to enhance healthcare services by improving the quality of care, reducing the cost of services and enhancing the involvement of patients for decision making about their illness. This definition will be used for the purpose of this study.

Kwankam (2004) simplifies the definition to the following "any electronic exchange of health related to data collected or analysed through an electronic connectivity for improving the efficiency and effectiveness of healthcare delivery".

Wysocki (2001) states that

"... e-health refers to all forms of electronic healthcare delivered over the Internet, ranging from informational, educational and commercial "products" to direct services offered by professionals, non-professionals, businesses or consumers themselves. Ehealth includes a wide variety of the clinical activities that have traditionally characterized tele-health, but delivered through the Internet. Simply stated, e-health is making health care more efficient, while allowing patients and professionals to do the previously impossible"

Health Canada (2006: 1) simplifies the definition of e-health by stating that it encompasses a whole range of purposes from purely administrative through to healthcare delivery. For example:

 In the hospital care setting, e-health refers to electronic patient administration systems; laboratory and radiology information systems; electronic messaging systems; and, telemedicine – tele-consults, tele-pathology and tele-dermatology – to name but a few.

- In the home-care setting examples include tele-consults and remote vital sign monitoring systems used for diabetes medicine, asthma monitoring and home dialysis systems.
- In the primary-care setting, e-health can refer to the use of computer systems by general practitioners and pharmacists for patient management, medical records and electronic prescribing.

More importantly, Irving Levin Associates (2006) state that e-health refers to a sector that encompasses all the companies providing healthcare IT solutions that are web-based or include an Internet-based component, serving insurers, consumers, doctors, pharmaceutical companies, contract research organisations, radiologists and all healthcare professionals on both the clinical and administrative sides of the business.

As a result, e-health focuses on the use of ICT to enable health programmes or systems through information, and enhances healthcare service delivery, the health of its recipients and its human environment (Uys, 2006). E-health has produced several important effective interventions (Glasgow, 2007: 119). It is important to examine at the characteristics of e-health.

It is evident from the above definitions that the key elements of e-health are to bridge the digital divide, to facilitate cost reduction and an enhanced quality of healthcare and to improve service delivery through the appropriate use of ICT. This study adopts the definition of e-health that maintains that e-health is the use of ICT to enhance healthcare services by improving the quality of care, reducing the cost of service and enhancing the involvement of patients in or decision making about their illness. Using this definition, it is important to look at the role of ICT in healthcare.

2.4.2 The role of ICT in healthcare

Over the last decade, the need to develop and organise new ways of providing efficient healthcare services has been accompanied by major advances in ICT, which has resulted in

an increase in the use of ICTs in healthcare, collectively known as "e-health", which promises to have an enormous impact on all healthcare elements, from delivering the information people need to lead a healthy lifestyle to providing new tools to design tomorrow's medicines; from making healthcare systems more efficient and responsive to providing "in the home" and mobile healthcare technologies (Europa, 2006).

Mansell and Wehn (1998) recognise ICTs' role by stating that ICT applications play a valuable role in the medical field because they provide support to several elements of healthcare, such as efficient information sharing among health professionals and facilitating transfer of patient records between healthcare centres. They have the capability to enhance clinical effectiveness, continuity and quality of care by health professionals. They further provide solutions such as telemedicine which enable people in disadvantaged remote settings to receive medical services.

In concurrence with the above, the WHO report shows that the adoption of ICTs in health is not simply concerning technology adoption (Dzenowagis, 2005), but is intended to reach a series of desired objectives, according to (McNamara, 2008):

- support health workers in making better treatment decisions;
- enable hospitals to provide higher quality and safer care;
- facilitate a platform that enables people to make informed decisions about their own health;
- ensure that governments are becoming more responsive to health needs;
- provide national and local information systems supporting the development of effective, efficient and equitable health systems ;
- ensure that policymakers and the public become more aware of health risks .

As a result, there is an increase in e-health developments in South Africa, which have the potential to improve healthcare services. These e-health developments are viewed as a vehicle for bridging the digital divide between rural and urban healthcare centres.

The following are the potential effects of ICT on healthcare:

- ICTs have the capability to bring the health system and the healthcare provider to the patient by providing a mechanism for remote data access, health information sharing and medical support (Ouma & Herselman, 2008) and clinical examination, diagnosis and treatment therefore reducing the effects of geographic isolation, harsh climate and low population densities (Alvarez, 2002).
- ICT enhances comprehensive service delivery by enabling countries in the region to focus on producing the services in which they have comparative advantages and delivering them as part of inter- or intraregional trade (Ouma & Herselman, 2008). Moreover, ICT enhances service delivery by allowing citizens to obtain the benefits of economies of scale by improving the access of the poor to basic services; promoting service delivery optimisation; and creating an incentive for the development and transfer of new technologies and products (UNDP, 2006).
- E-health promotes the quality of the services offered in the healthcare sector by reducing redundant tests and medical errors through facilitating electronic health records. In addition, it saves patients from going to hospital needlessly, allowing the patients to be served in their own communities or at home (Alvarez, 2002).
- ICTs provide advanced technology to improve the delivery level of healthcare in rural communities through tele-health. This system is used to connect highly experienced medical specialists anywhere in the world with rural hospitals and enable experts to give advice, teaching or assistance in a difficult diagnosis (Pagliari, Sloan, Gregor, Sullivins, Detmer, Kahan, *et al.*, 2005).
- Investment in ICTs supports continuity of care by allowing clinicians to communicate among them using electronic patient records and the web services provided. Furthermore, patients communicate with the hospital through the communication structures available, thus avoiding unnecessary hospital visits (European Commission, Enterprise and Industry Directorate General, 2006: 11).
- The use of ICTs in the health sector gives stakeholders maximum benefits, some of them being that the medical professionals can continue their medical education in isolated locations, pharmacists can have access to patients' records and information can be shared between interested parties in the same facility (Ouma & Herselman, 2008). It supports clinical decision making, reduces repeated clinical interviews with

the patients, as well as multiple tests, and avoids unnecessary referrals for patients (Alvarez, 2002).

It is evident that the contribution of ICTs to healthcare cannot be ignored. Investment in ICTs in the healthcare sector should be increased to improve the quality of service. However, there should be an emphasis on how these ICT solutions are developed and implemented in healthcare, especially for rural areas, hence, this study investigates how QA can be ensured in e-health acquisitions. The next section highlights some of the characteristics of e-health.

2.4.3 E-health potential

When implemented successfully, e-health promises several potential advantages. Table 2.1 shows the most commonly cited characteristics of e-health that provide these advantages.

Characteristics	Descriptions	
	According to European Communities (2006: 23-24), efficiency is reflected in the	
	optimisation of resource utilisation, improved productivity and avoidance of waste;	
Efficiency	conditions which exist after the implementation of e-health solutions.	
	According to Brussels (2006: 6), e-health is capable of making the work of	
	administrators easier through the system that it provides; hence health administrators	
Administrative support	are able to ensure the proper organisation of the health sector. In addition, e-health	
	provides administrators with better results with the few resources that are available.	
	E-health enables evidence-based choice by providing avenues for patient-centred	
Empowerment of	medicine using electronic health records and the Internet in order to obtain the	
consumers & patients	information required (Alvarez, 2002).	
Characteristics	Descriptions	
	According to Tan (2005), one of the most important characteristics of e-health is the	
Interoperability	fact that it has the capacity to enable information exchange between healthcare	
	organisations in a standard way. This actually expands service and growth in	
	healthcare organisations.	
	Timeliness may not necessarily be fast treatment as assumed; but when information is	
Timeliness	provided to all stakeholders such that schedules are met appropriately, timed	
	healthcare exists (European Communities, 2006); this is definitely provided by e-	
	health	

Table 2-1: Characteristics of e-health solutions

	E-health enables medical professionals in rural areas to have access to information on		
Education of medical	topics that they are interested in by using the Internet to conduct research and also		
professionals	view particular journals and papers. Traditionally, this would not have been possible		
	because of the infrastructure divide (Rebane, 2006).		
	By using the information that is available through e-health, possible harm and the risk		
Safety	of potential injury to patients is minimised. Consequently, there is improved safety in		
	the healthcare sector (European Communities, 2006).		
	The fact that e-health patients and consumers can make a comparison between		
Quality	different providers and choose the best option forces providers to give better service		
	thereby increasing the quality of the services provided (Alvarez, 2002).		
	E-health promotes equity of access for all and allows the provision of services to more		
Access	citizens within a given period of time.		

As previously discussed, technologies have long been relied on and form the backbone of healthcare. ICTs, as one category of several available technologies, promise greater potential, new and increasingly evolving innovations for healthcare under the umbrella of e-health. While e-health promises different benefits for different stakeholders, several studies have shown that their awareness and involvement is a key success factor for any ICT project implementation. In light of this, it is important to highlight the potential stakeholders of e-health solutions and this is discussed below.

2.4.4 Stakeholders of e-health

The other important aspect of ICT project success is user-involvement, as previous studies have shown that cooperation is fundamental for any project to be both scalable and sustainable and that, within the context of such projects, the technology recipients must be involved at every stage (Hosman & Fife, 2008; Schwalbe, 2007; Avison & Fitzgerald, 2006; Shelly *et al.*, 2008). Thus, it becomes important to consider the stakeholders for any ICT application including e-health. Schwalbe (2007) defines project stakeholders as individuals and organisations that are actively involved in the project, or who are affected by the project execution or project completion.

The role of ICT is critical in the healthcare sector and has enormous benefits that affect the daily operations of hospitals (Bernstein *et al.*, 2007; Clark, 2007). E-health stakeholders have, therefore, embraced its use to effectively make use of the gains that it provides (Ouma & Herselman, 2008). Ahern, Kreslake and Phalen (2006) maintain that while no specific sector originated the idea of harnessing ICTs to address healthcare issues, physicians, other practitioners, healthcare delivery systems, patients, developers and academics all bring unique perspectives to, and have sometimes divergent opinions about, maximising the potential of e-health.

, Austin and Boxerman (2003) state that e-health stakeholders are the employers who want to analyse healthcare costs and utilisation by employees; the patients who are looking for information about their health; the providers who want to save time and money by streamlining communication; the health planners who are struggling to strengthen relationships with members; and the providers who are attempting to reduce the cost of business through ICT.

It is, therefore, evident that e-health stakeholders include consumers, physicians, health providers, health insurers and even academics (Tan, 2005; Ahern *et al.*, 2006). Certainly, these stakeholders have embraced e-health because of the benefits it provides, ; however, some challenges still exist. Tan (2005: 379–381) points out the opportunities and challenges that exist for e-health stakeholders as shown in Table 2-2.

Stakeholders	Opportunities	Challenges
Consumers	 Equipped with information therefore can make better judgements 	 Security and privacy of information is a great concern.
	 Improved quality of care 	 Those who do not have access to the Internet miss the chance to get the detailed information required.

Table 2-2: Opportunities and challenges for e-health stakeholders

	Those in rural areas can benefit from	There is the possibility of losing
Physicians	telemedicine.	patient relationships.
	Can use the Internet to obtain	• May be slow in adopting e-health
	information on various topics and	techniques.
	participate in ongoing medical	
	education courses.	
	Gain from reduced costs and increased	The cost required for e-health
Health providers	efficiency.	implementation is high.
	Can use the Internet for online	
	marketing.	
	• The Internet opens a market for	 Security and privacy is a challenge for
Healthcare	conducting business with organisations	companies that deal with sensitive
vendors	and patients.	data on organisations and patients.
	• Are able to market products and	E-health solutions require one to
Healthcare	services and obtain customer	invest substantial capital and effort.
insurers	information online.	

Source: Tan (2005: 379-381)

Different stakeholders have different needs. Hence, e-health innovations continue to produce solutions that meet their requirements by tailoring solution to meet certain sets of requirements. The next section discusses these solutions in more detail.

2.4.5 E-health solutions

E-health provides solutions that are tailored to meet the varying needs of individuals and the healthcare sector and to enhance healthcare services. These solutions have great potential for developing countries, where healthcare sectors are faced with many challenges. For the purpose of this study the various solutions for South Africa are used, stating a brief background on its healthcare challenges below.

One of the main challenges for the South African healthcare sector is the variety of diseases it has to deal with. The reported prevalence of HIV in adults is 16.6% (WHO, 2008) and, until recently, South Africa was reported to have more HIV-positive people than any other nation. Data from 2003 show HIV/Aids as the greatest cause of death (30%), with cardiovascular disease (17%), intentional and unintentional injuries (12%), and non-HIV-related infectious

and parasitic disease (10%) and malignant neoplasms (7.5%) as the next major causes (Bradshaw, Groenewald, Laubsher, Nannan, Nojilana, Norman, *et al.*, 2003).

In response to these statistics, the National Department of Health (NDOH) in South Africa has begun to explore the opportunities promised by e-health solutions. Thus, it has implemented several public health information systems, notably the District Health Information System (DHIS) and the National Electronic TB Register. The Department has initiated the Mindset Health Sentech Closed Health Broadcast Channel, which aims to communicate basic healthcare information to illiterate people within rural hospitals through digital media. More recently, the NDOH has formulated an e-health strategy for South Africa which highlights the purpose of the national e-health strategy in the context of problems of diseases and poverty. A strategic framework for the implementation of an Electronic Health Record System in South Africa (eHR.za) has also been developed (NHIS, 2007).

The implementation of e-health solutions in hospitals spans several different departments and has various aims of use and benefits. Austin and Boxerman (2003) classify the areas of e-health as e-business, consumer marketing, organisational management and clinical customer service.

The IOM (2001: 166–167) concurs with the above by indicating the different areas that benefit from e-health solutions, including consumer health, clinical care, administration and financial transactions, public health and professional education and research, which have all been indicated to be beneficiaries of different e-health solutions. A summary of these statements is shown in Table 2-3.

E-health solutions	Healthcare sectors
Health information systems	Administration, finance and public health
Electronic health records	Administration, finance and patient empowerment
Internet-based solutions	Consumer informatics, business operations, professional
	education and research
Telemedicine	Clinical care

Source: Adapted from Ouma & Herselman (2008)

From Table 2-3 it is evident that e-health solutions are available to support all the different needs of healthcare services to ensure and enhance service delivery and promote the quality of care. Some of these solutions provide their users with convenient ways to access accurate and mission-critical information to enable them to make informed decisions about healthcare management and patient care. An overview of these solutions is provided.

2.4.5.1 Health information systems (HISs)

There is an increasing demand for health information to inform policies, priority setting, resource allocation, monitoring of the impact of health programmes, and progress towards goals (Rommelmann, Setel, Hemed, *et al.*, 2005; Shaw, 2005; Reichertz, 2006). Managing a health system requires various types of information from a variety of sources. Data collection within the health system includes disease surveillance, facility surveys and routine reporting of health service statistics (Rommelmann *et al.*, 2005). HISs aim to ensure the appropriate and effective use of resources to improve health service performance and the health of the community (Garrib, Stoops, McKenzie, Dlamini, Ovender, Rohde & Herbst, 2008). Therefore, these systems collect, analyse and convert data into information that will be useful for determining health system actions (Mbananga *et al.*, 2002). Such data must be reliable, accurate and timely. However, few developing countries have the ability to implement such procedures effectively (Shaw, 2005; Odhiambo-Otieno, 2005; Garrib *et al.*, 2008).

There are several health systems in this category, the most important of which include hospital information systems and public health systems. Hospital information systems assist in running the workflows of medical services with regard to financial, administrative, management and insurance issues (Liu, Yang, Yeh & Wang, 2006). Furthermore, information is pivotal for effective clinical management because it facilitates informed decision making, which in turn benefits the community being served (Abouzahr & Boerma, 2005; Mirchevi, 2005).

In South Africa, the government is pioneering the implementation of such systems with attempts to overcome some of the many challenges in the healthcare sector. As a result, a number of health systems have been adopted which will be discussed in the following section:

2.4.5.2 District Health Information System (DHIS)

According to Mars and Seebregts (2008), the DHIS is one of the best-established public health information systems functioning in South Africa. it was originally developed by the University of Oslo and the Health Information Systems Programme (HISP) in collaboration with the South African National Department of Health. This system, which was developed to collect aggregated routine data from all public health facilities in a country, is intended to support decentralised decision making and health service management (Heywood & Rohde, 2001). It is regarded as a user-friendly, easy-to-use, free and open source (FOSS) system for conveniently collecting and sharing aggregated data collected at health facilities and transmitting these data to higher levels in the public health system (Mars & Seebregts, 2008).

The DHIS is designed to support health workers and managers at all administrative levels, maintaining a balance between flexibility and standardisation with a strong emphasis on using information for local action. The DHIS aims at developing a culture of information use among healthcare workers through the development of knowledge and skills in data handling to create locally relevant information for use in the management of district-level health programmes (Williamson, Stoops & Heywood, 2001). Furthermore, the DHIS allows healthcare workers to analyse their levels of service provision, predict service needs and assess performance in meeting health service targets (Williamson *et al.*, 2001).

The data from the DHIS are fed to the District Health Barometer (DHB), which is a tool for monitoring and supporting the improvement of the equitable and efficient provision of primary healthcare in South Africa. It monitors a selected set of socioeconomic and healthcare indicators. A report is drawn up annually based on the data from the DHIS, StatsSA, the National Treasury (BAS data) and the national TB register. This report seeks to highlight inequities in health resource allocation, inputs, outputs and outcomes, and the efficiency of

health processes between provinces and between all districts in the country, with particular emphasis on rural and urban districts (Mars & Seebregts, 2008).

Currently, the software is used in all nine provinces by approximately 200 users at various levels (i.e. sub-district, district, province, national, etc.). The national database contains more than 1 million patients for the period 2003 to 2005 (NDoH, 2008).

However, the process of collecting data from the district hospitals is still, in most cases, on a manual basis which could lead to inaccurate information, resulting in incorrect evaluation and wrong decision making. This may compromise the quality of services.

In Garrib *et al.*'s (2008) study of the impact of the DHIS, it was reported that improvements in the completeness and quality of data collected through the DHIS were compromised by such shortcomings as delays in the submission of data owing to the non-delivery of forms, poor understanding of indicators, unreliable data quality, facility managers not maintaining data summaries and poor feedback. Furthermore, a perceived high work burden associated with data collection and collation and the ineffective use of some data collation tools were found to be the shortcomings. However, a positive effect was found in that managers were using the information for facility-level decision making (Day & Hedberg, 2004). Another project in South Africa is discussed next.

2.4.5.3 Mindset

Mars and Seebregts (2008) define this project as the use of ICT resources for communicating basic healthcare information to illiterate people.

Mindset is a partnership between the Mindset Network, the National Department of Health and Sentech. Mindset sources and creates digital health educational content in video, computer-based multimedia and print formats in five of the 11 official languages. It is best known for its satellite-based, closed broadcast channel for health, which is broadcast directly to over 280 hospitals and clinics in South Africa (Mars & Seebregts, 2008). The receiving TV sets are usually set up in the outpatient clinic waiting room and patients watch the broadcasts while waiting. This project initially focused on HIV/Aids, tuberculosis and child survival, but has recently expanded to include sexually transmitted diseases, which are included in the content of an edutainment drama series aimed at young people in South Africa.

The evaluation of the series has shown that the programmes have positively affected attitudes towards stigma, HIV/Aids testing and condom use. In some of the poorer areas, enlightened hospital managers have allowed local community members access to their hospitals at night to watch these programmes (Mars & Seebregts, 2008). In KwaZulu-Natal, 22 touch-screen kiosks have been introduced to provide patients with healthcare information in their own language. This is a promising solution that could bring change if it could be implemented in an appropriate manner in rural communities. Another e-health solution that is popular for reducing cost and medical errors are electronic health records, which is discussed below.

2.4.5.4 Electronic health records (EHR)

As indicated in chapter 1, the healthcare sector is faced with many challenges. It has been stated that the major cause of the high death rate and increased cost of operation in hospitals is caused mainly by medical errors. Paper-based systems have been reported to be ineffective because they result in medical duplication or loss of medical records which leads to inaccurate decision making and unnecessary costs.

Medical records are important but they are often lost or misplaced . As a result, histories of past diagnoses are lost (Blair, 2007). Additionally, when emergencies occur, many people do not have their medical records available which complicates decision making (Novak, 2005). This can lead to medical errors or duplications that result in increased cost or even harm to the patient . To address the inconsistencies, electronic health records (EHRs) have been introduced. EHRs allow message transfer, shared health records, the delivery of personal healthcare services and support for external information requests (Novak, 2005). Consequently, this leads to a reduction in medical errors, reduction of costs, time savings, increased access to medical information and improved quality (Blair, 2007). EHRs are the

fundamental building block for all e-health applications and they allow the sharing of essential information between care providers across medical disciplines and institutions (Health Canada, 2006). EHRs creates significant value, providing a longitudinal view of clinical information. The record is available electronically to authorised healthcare providers and the person anywhere and anytime in the support of care. This record is designed to facilitate the sharing of data across the continuum of care, across healthcare delivery organisations and across geographical areas.

An EHR is software that allows a user to create, store, organise, edit and retrieve patient records on a computer. Advanced EHRs allow the user to automate many time-consuming, paper-driven office tasks. They allow for electronic prescribing and medication refills, automatic formulary checking, electronic lab, imaging and referral ordering, automated charge capture, automated coding advice, inter-office and intra-office clinical messaging, multiple note creation options, remote access to the chart, results flow charting, clinical alerts, patient education and disease management (Adler, 2004).

In South Africa, an EHRs solution has been implemented in the Inkosi Albert Luthuli Central Hospital at Cato Manor near Durban, KwaZulu-Natal. This hospital has been developed as a private public partnership and is regarded as a state-of-the-art, paper-less hospital. While initially intended to be paperless, it is, in fact, paper-less (less paper, not no-paper) as reported by Mars and Seebregts (2008).

The Western Cape has developed an in-house primary healthcare application. In addition to this widespread hospital system, several other smaller systems have been implemented particularly at smaller clinics, including solutions such as Therapy Edge43, OpenMRS, and others. Furthermore, a tender process has been initiated by the NDOH for an Electronic Health Record for South Africa, known as eHR.za.

There has been significant development in EHR systems in South Africa and, in some cases, systems have been established across entire provinces. However, there are still many

facilities that do not have access to basic computerised facilities or electronic patient management (Ruxwana, 2009; Mars & Seebregts, 2008; COFISA, 2008).

A solution, that is gaining momentum and promises to have great potential for rural communities, are the innovations invested in the Telemedicine system, which are discussed next.

2.4.5.5 Telemedicine

In South Africa, many people live in rural areas, where effective healthcare provision is lacking. In such communities, there are some who can afford to travel to the cities for better healthcare. However, , the majority who cannot afford better healthcare services means the burden of healthcare falls on the local hospitals. These are responsible for transferring the most serious cases to urban hospitals for advanced healthcare. The urban hospitals are faced with dealing with huge numbers of transferred patients which use their limited resources. In response to this, ICTs are beginning to be used innovatively to bring healthcare to the people in a more effective manner. Telemedicine is one way this can be done (Mars & Seebregts, 2008).

The NDOH (2010) defines telemedicine as the use of ICT to provide medical information and services at a distance. Telemedicine allows for the better utilisation of limited medical personnel and resources. It has the potential for improving access to, and the quality of, medical care at lower costs. Telemedicine may be seen as a valuable tool for providing muchneeded medical services to the underserved rural areas. It can enhance the continued medical education of young doctors, nurses and other healthcare practitioners in rural areas, both in training and in an established practice.

According to Johnston (2006), telemedicine is the use of ICTs as a method of delivering healthcare, education and related services. The common goal of any telemedicine application is to increase access to and ease of healthcare, especially for rural and underserved populations. It increases access to specialty care and education, and communication with larger, more sophisticated hospitals, which allows rural doctors and clinicians to maintain a

working relationship with their peers, and can increase their professional and social connections to the medical realm and its information flow.

The Medical Research Council (MRC) (2001) states that telemedicine is the use of ICTs to provide or support clinical care at a distance. Telemedicine includes the use of such technologies as e-mail, videoconferencing and SMSwhich allows health workers in rural areas to get expert help when diagnosing and managing difficult conditions.

In short, telemedicine can be defined as the provision of various medical activities from a distance (Wooton, Craig & Patterson, 2006). Some of the benefits of telemedicine include reaching the undeserved population to provide medical services that were inaccessible. Additionally, it allows medical professionals to get second opinions, thereby, promoting efficiency among other benefits (Hjelm, 2006; Maheu *et al.*, 2001).

Telemedicine is evolving and, according to the International Telecommunications Union (ITU) (2005), it is a powerful tool for improving healthcare delivery that has been successfully implemented in pilot projects in many countries. Many of these pilots clearly demonstrate that telemedicine can improve the diagnosis and treatment of specific conditions.

Although telemedicine can be highly effective, a SIDA report (Greenberg, 2005) notes that cost is an issue: *"In its high-tech implementations, it is unlikely to be cost-effective or affordable in widespread use. Those implementations requiring high bandwidth and sophisticated remote equipment have generally proven practical in cases where money is not an issue or as an alternative to high-cost air transportation and lodging."* Used wisely, however, telemedicine can be a cost-effective method that richer countries can employ to aid capacity building in the healthcare systems of poorer countries (Johnson, Kennedy & Murdoch, 2004).

In South Africa, this solution has been deployed in several rural hospitals. One success story is the Tsilitwa Clinic in Qumbu Village in the Eastern Cape Province which is one of the poorest provinces with the majority of its population living in rural areas. However, the sustainability of such systems is still a problem. Ruxwana(2009) discovered that , for example, the Tsilitwa solution had not been working for more than four months owing to technical problems that could not be fixed. Such circumstances hinder communities from benefiting from solutions such as these (Ruxwana, 2009). Furthermore, it was found that many rural hospitals have received telemedicine equipment which has not been used because there is no awareness of its use and benefits.

As emphasised by the ITU (2005), telemedicine is more than the delivery of hardware and software. Incorporating already-existing technology – such as phone or e-mail – into medical practice, routine consultancies can make a difference. Hence, this study aims to ensure quality at the implementation of such systems to ensure sustainability and add to the benefits for communities. E-health innovations are evolving and promise to have solutions that will cater for everyone, from the poor to the richer. Other solutions are discussed next.

2.4.5.6 Internet-based e-health solutions

The evolution of the Internet has made access to products, information and services instant and universal (Maheu *et al.*, 2001). These products and services have extended to healthcare provisioning. E-health innovations provide online solutions that can provide products, information and services to communities that enhance their wellbeing. As a result, communities in the developed world are constantly looking for information about their health online (McMullan, 2006).

The online capabilities of e-health facilitate learning for healthcare professionals. Healthcare professionals use these capabilities by visiting various sites that offer medical education and health information online (Welch, 2007). Additionally, pharmaceuticals, hospitals and billing insurance companies are purchasing products online and advertising the services they provide (Hanson, 2006). Several databases, libraries and conferences exist online that researchers use daily (Maheu *et al.*, 2001). The Internet has been used as a tool for online experiments, surveys and randomised controlled trials (Couper, 2007) thereby promoting research.

As mentioned earlier in this chapter, Internet provision for rural communities has been a focus of ICT for development for many years and several solutions have been adopted in South Africa to enable Internet access for such communities. Despite the positive developmental impact of ICTs, most of rural South Africa has not benefited as these areas are the worst affected in terms of access to ICT infrastructure and services. It has been found that only 2.3% of rural households own or have access to a computer in South Africa, and only 5.4% own or have access to a landline (COFISA, 2008). Thus, these e-health solutions will mostly benefit urban communities where computer access and Internet access are widespread.

In addition to the above solutions, mobile phones are being used to gain entry to the healthcare sector for improved service delivery, as discussed below.

2.4.5.7 Mobile e-health

Although the South African telecommunications market is the largest in Africa, broadband penetration remains low and bandwidth is expensive. However, cellular telephony is one of the fastest growing industries in South Africa. Mobile phones have given access to millions who were previously marginalised from personal communications, and mobile phone penetration is estimated at 75% with approximately 90% of the country covered by mobile telephony (Mars & Seebregts, 2008).

Furthermore, Waverman *et al.* (2005) have found that mobile phones are having a positive and significant effect on economic growth in developing countries. In fact, they find that because mobile phones provide the primary method of communication in developing countries with no or few fixed lines, the growth impact for developing countries may be twice as great as for developed countries in which attributable growth would be split between fixed line and mobile phone.

Accordingly, interest in the development of mobile e-health applications has increased and South Africa has initiated several mobile e-health projects, such as OpenROSA,. This is a project coordinated by an international consortium of open source developers, including the MRC and Cell-Life from South Africa, which aims to develop open source health data collection and management applications for mobile phones and personal digital assistants (PDAs). Cell-Life is working on Cellphone for HIV, a wider project to use cellphones for mass messaging around HIV (Benjamin, 2008). The Aftercare System has been introduced, which has assisted home-based counsellors in the collection of adherence and social information on ART patients. The system has made t their jobs easier and saved time which allows them to care for more patients (Mars & Seebregts, 2008).

It is likely that the use of mobile phones in healthcare will play an ever-increasing role in medical informatics, telemedicine, surveillance and healthcare education in Africa (Mars & Seebregts, 2008). Hence, there are several other solutions for healthcare being developed in South Africa. However, concerns, relating to sustainability; development of suitably trained and skilled staff to participate in and manage these programmes, and the need for the systems to be interoperable, have still not been properly addressed. Thus, this study aims to devise mechanisms that will ensure the quality of e-health systems at the time of their development.

From the above discussion, it is evident that the use of ICTs is essential in healthcare and this has been proven in developed countries, which take advantage of these solutions for better health and human development. According to the Europe Information Society Report (2007), innovative IT-based solutions are used in all European countries for the purposes of improving quality, efficiency and accessibility in the healthcare sector.

Hence, in developed countries, the computerisation of medical records in hospitals and health clinics, the use of the Internet for communication and information exchange, and the development of magnetic cards for user identification, electronic scheduling systems for appointments, examinations and hospital admissions, and computerised protocols for diagnosis and treatment support, are just a few examples of the various e-health applications available (Tomasi, Facchini & Maia, 2004: 867).

Consequently, developing countries have seen the benefits of e-health solutions and have begun their implementation. However, these implementations are still lagging behind the developed world. A survey conducted by the World Health Organization (WHO, 2006) between 2005 and 2006 found that there is a relationship between e-health and country income groups, and that developing countries are still in the initial stages of implementing e-health-based solutions.

According to Samake and Mbarika (2007), the reason why Africa may be still in the initial stages of e-health implementation is because these countries are dealing with many issues, including issues of the past. These include war, disease and poverty, which affect the provision of medical care for both the rich and the poor. In concurrence, Sanders and Chopra (2006) mention that the socio-technical environment precludes any significant advance in the diffusion of e-health in Africa since many Africans, especially the inhabitants of rural Africa, who represent the majority of the African population, have limited access to electricity, the Internet or, most importantly, an adequate education.

However, Richardson (2006) argues that healthcare providers and governments have no choice but to meet healthcare demands for future citizens and the application of e-health is therefore fundamental. In addition, Ojo (2007) advocates that information and communication exchange between healthcare stakeholders should be strengthened to overcome some of the healthcare challenges that Africa is facing. This would increase access to information by consumers and accelerate knowledge diffusion, among other benefits.

Although the introduction of ICTs for development promises to have great potential for developing countries, especially for healthcare within e-health solutions. Some developing countries may resist allocating funds to the adoption of e-health projects owing to the reported higher failure rate of ICT projects and may rather use those funds for other developmental areas which are perceived as being of critical importance with the promise for future growth. Gichoya, Hepworth and Dawson (2006: 79) mention factors affecting the success or failure of government ICT projects in developing countries and state that, as developing countries embrace e-government projects, the economic justification of ICT projects is no longer a

problem but the failure rate of such projects may lead to a waste of resources (Gichoya *et al.*, 2006: 79).

These factors motivate the investigation of the cause of ICT project failure to take measures to avoid the known challenges from re-occurring when adopting new ICT solutions in the rural areas where there are so many needs that a solution adopted has to fulfil. An overview of a ICT project failure is given below.

2.5 UNDERSTANDING ICT PROJECT FAILURE

The importance of ICTs in the healthcare sector is increasing as organisations develop solutions which attempt to reduce the costs of care, improve service delivery and the quality of care and patient safety. Littlejohns *et al.* (2003) further state that an enormous investment has gone into computerised hospital information systems worldwide.

However, critical implementations of these e-health solutions are seen mainly in the developed world. This may be due to the many challenges that have been discussed which are linked to the digital divide, issues of the past, lack of infrastructure, services and knowhow, limited resources, low literacy levels and professional isolation, and low income levels (Herselman & Jacobs, 2003; Olugbara *et al.*, 2006; Uys, 2006; Littlejohns *et al.*, 2003; Samake & Mbarika, 2007; WHO, 2006; Ruxwana, 2009; Ruxwana *et al.*, 2010, COFISA, 2008).

Conversely, the lag in implementation may be due to a higher failure rate of IT project implementation, as reported in the Standish Group's CHAOS reports of 1994 and 2004. According to the 2004 CHAOS report, in spite of an improvement in the delivery of IT projects in recent years, the failure rate is still high especially in larger initiatives. The report states that only 29% of IT projects throughout the world are successful, that is, delivered on time, within budget, and with the required features and functions.

It is, therefore, important to look at both the challenges of ICT implementation in developing countries and IT project failure, which are outlined in sections below.

2.5.1 Challenges with ICT implementation

Heeks (2002: 103–104) reveals that the factors influencing the success of ICT implementation tend to be "situation specific" or contingent. When technology is introduced, there is the danger of a lack of fit between the "tool" and the "task" – a "design-actuality gap".

Access and infrastructure are key precursors to ICT adoption, as stated by most researchers, they cannot in themselves guarantee benefits. Rather, it is the exploitation of technology to further business aims that will contribute to growth (Matthews, 2007; Herselman & Jacobs, 2003).

According to Matthews (2007), the principal inhibitors of ICT-enabled expansion are classed as financial (ability to invest in ICT), infrastructural (bandwidth and power) and organisational (lack of skilled staff, lack of coherent strategy, inability to evolve to new ICT-enabled processes). The most cited reasons for failure to exploit ICT opportunities are the lack of a fast and reliable Internet connection and the cost and reliability of telephone links. While there have been developments in broadband penetration in many countries, access remains a problem in rural areas (COFISA, 2008), and connection to fixed-line telephone exchanges also remains costly (Qiang *et al.*, 2006).

Unreliable and expensive power supply remain a barrier in many countries, where an overregulated environment leads to excessive compliance costs for small firms (Haque, 2005). Power problems will clearly affect investment in ICT, particularly the development of data centres with a need for high power availability (Matthews, 2007).

The lack of capacity to exploit improved ICTs within business is another key constraint to wider adoption. Capacity in this sense includes low levels of IT literacy and lack of experience of ICT integration (UNDP, 2006). Failure to increase staff capacity can be attributed to the

high cost of attracting skilled staff and retaining them (Qiang *et al.*, 2006; COFISA, 2008). Also of major significance is the organisation's ability to adapt to new operational models afforded by new technology projects (INFODEV, 2006). This becomes more of a challenge in rural development because the concept of "best practice" does not apply to rural development in general, and ICT-enabled rural developments in particular. There are pros and cons for every conceivable model (COFISA, 2008), therefore, a "one-size fit-all" solution is not appropriate.

Conversely, many countries have embarked on developing policies and finding ways to try and overcome these challenges. In Africa, strategic training initiatives are being introduced to provide support and mentoring in ICT and help reduce the "brain drain" (UK House of Commons, 2006). In response to bandwidth constraints, some countries are assessing the provision of free or subsidised Internet access for SMEs, for example in the Philippines (Visayan Daily Star, 2006). Others are looking at taking advantage of mobile networks because they have penetrated most of the developing countries, including the rural areas.

2.6 CONCLUSION

From the discussion in this chapter, it is evident that ICTs are a key factor and act as the backbone of competitive advantage for many organisations. It is evident that, through e-health initiatives, ICTs can provide solutions that may overcome the complicated challenges faced by the healthcare sector. Although ICTs have potential for developing countries, where a large proportion of the population live in rural areas, their implementation has been shown to still lag behind the developed countries because of the challenges they face, including the digital divide, issues of the past, low income levels, lack of infrastructure, and limited power supply (to name just a few).

Although some developing countries have initiated ICT-for-development projects, it was revealed that some may be discouraged from continuing because of the high failure rates reported for ICT projects. However, as seen in the Standish Group's 1994 and 2004 CHAOS reports discussed in this chapter, the introduction of formal QA in project management has

increased project success to 29%. This is supported by Jones (2004), who states that the six most common problems for failed projects relate to project quality management and include: poor project planning, poor cost estimating, poor measurements, poor milestone tracking, poor change control and poor quality control. What is interesting about these six problem areas is that they are all associated with project quality management rather than with technical personnel. It becomes evident that inadequate project quality management is a contributing factor to project failure. Hence, this study emphases the implementation of QA in project management for the successful implementation of e-health solutions.

In this chapter, notions of ICT for development, ICT for rural areas and for healthcare, ehealth and its challenges are discussed. This chapter further gave an overview of the challenges and a literature study on ICT project failure. It is argued in this chapter that ensuring project quality management – QA – can lead to sustainable e-health acquisition that enhances service delivery and improves the quality of life for rural communities.

3 QUALITY: NOTIONS, STANDARDS, MODELS AND METHODOLOGIES

3.1 INTRODUCTION

One of the challenges facing the South African healthcare sector, in the context of service delivery, is to improve the quality of services provided by healthcare centres and hospitals to the communities, especially the rural communities. High-quality service is essential for competitiveness and can even improve the employees' job satisfaction. Quality service is an imperative for competitiveness and customer satisfaction and a sign of quality maturity (Foster, 2007: 231). If e-health solutions are adopted to enhance the quality of services, then it is important to invest in their quality during their development and implementation. As a result, quality management strategies in e-health acquisition projects become critical.

Although this need for quality management has been recognised, the accessible research publications are currently focusing predominantly on quality control and the implementation of quality management systems in organisations. Those Those that do focus on quality management at the project level as project quality management, have a limited scope in terms of emphasising QA processes in project quality management, especially their applications in systems development projects. Therefore, the focus of this study is to seek mechanisms or methods to ensure the continuous improvement of services through acquired e-health solutions by promoting project quality management, with the emphasis on QA elements, as a success factor for ICT projects. In order to meet these goals, this study will investigate methods and frameworks for assuring quality in the implementation of such solutions.

ThThis chapter will define quality . An overview is provided of total quality management (TQM) as a systematic approach to quality management in organisations. Since this study focuses on e-health solution projects, quality management in projects is critical; hence project quality management is discussed and, within this discussion, the notion of QA . Furthermore, models and frameworks are discussed, which provide a systems perspective of QA. The roles

of a systems approach for QA with an overview of the ISO series of standards, including the quality management system for healthcare, are outlined. In order to develop an understanding of the concept "quality", it is therefore important to begin with definitions on the notions of quality, which are discussed in the next section.

3.2 NOTIONS OF QUALITY

The term "quality" in any given service is defined according to a variety of opinions in the literature (Frazier, 1997; Harvey & Green, 1993; Westerheijden, Brennan & Maassen, 1994; Green, 1994; Gryna, Chua & De Feo, 2007; Foster, 2007; Schwalbe, 2007). Table 3–1 outlines the theories of quality experts in which quality is defined.

Expect	Definition
Juran (in Juran Gryna & Bingham, 1974)	Juran's quality improvement approach emphasises project-by-project implementation and the
	breakthrough sequence. Juran warns against taking shortcuts from symptom to solution
	without finding and removing the cause. In addition to statistical process control (SPC), he also
	provides several problem-solving tools. With his definition of quality as fitness for use, he is
	strongly oriented towards meeting customer expectations. By using a 12-point approach, Juran
	distils the famous trilogy, which identifies plan, control and improve (Frazier, 1997; Stamatis,
	1996; Strydom & Van der Westhuizen, 2001; Gryna et al., 2007).
Crosby (1979)	Crosby promotes the transformation of the quality culture. In his top-down approach, the
	participation of everybody in the process is characterised by the individual conformance to
	requirements. He suggests 14 steps to management as a blueprint and checklist for
	management to adopt within the process towards world-class quality (Stamatis, 1996; Strydom
	& Van der Westhuizen, 2001; Gryna <i>et al.</i> , 2007).
	Deming's strategy emphasises continual improvement and measurement. As he maintains, it is
	impossible to measure customer dissatisfaction, therefore he does not recognise the cost of
	customer dissatisfaction. Deming promotes workers empowerment to solve problems. He
Deming	distils the 14 points of his approach into a model of Plan-Do-Check-Act (PDCA). This model
(1982)	indicates a problem analysis process and quality improvement cycle. It also provides a focus
	on defect correction as well as defect prevention. Deming's approach relies on statistical
	techniques and it tends to be bottom up (Deming, 1982; Stamatis 1996; Gryna et al., 2007).
Expect	Definition

Table 3-1: Definition of "quality"
	Taguchi is focused on the function that defines any deviation from the target as a loss that
Taquchi	someone will have to pay for. His strategy is difficult for the novice, but provides guidelines for
(1986)	improvement and cost considerations for the service industry (Stamatis, 1996; Gryna et al.,
(1300)	2007).

The work of each expert, in the field of quality, has positive and negative aspects – no definition is perfect. Therefore, each company or service organisation must define quality based on its own objectives, goals, mission, culture and customers. It is not unusual for organisations to combine the best points and create their own definition of quality. This definition can be based on customer quality characteristics and key quality characteristic variables that have a cause-and-effect correlation with the key quality attributes (Stamatis, 1996; Frazier, 1997; Gryna *et al.*, 2007).

Clearly, the measurement of quality is controversial (Frazier, 1997: 1). There is no general agreement about which instrument to use to measure the quality of processes, and quality is, therefore, hard to define. Literature emphasises the fact that quality and goals cannot be separated, but at the same time it is important to have consensus about what is understood by the individual institutions as an operational definition of quality in their unique context (Stamatis, 1996; Gryna *et al.*, 2007; Foster, 2007). According to Seymour (1995: 78), "there must be a rigorous framework for performance improvement" and it is critical that one must have a "methodology for improvement".

Finally, it is evident that quality experts offer different shorthand definitions of quality – "fitness for use" (Juran), "conformance to requirements" (Crosby), "loss of society" (Taguchi), "predictable degree of uniformity" (Deming). These definitions are complementary and provide operational meaning at different phases of quality activities. Other authors have elaborated on quality as "customer satisfaction and loyalty" (Gryna *et al.* 2007).

The International Standards Organization (ISO) defines quality as the "totality of characteristics of an entity that bears on its ability to satisfy stated and implied needs" (ISO8042: 1994) or "the degree to which a set of inherent characteristics fulfils requirements" (ISO 9000: 2000).

Since the notion of quality may differ from organisation to organisation, the adoption of quality management systems in the different organisations becomes important. One approach in quality management implementation is a systematic one. Cobb (2003: 4) asserts that the significance of a systematic approach is it decomposes the complexity and provides a framework for understanding cause-and-effect relationships that are incorporated into the system. Furthermore, Jacobs (2003) asserts that a systems approach that views the business from a cross-functional perspective is essential for understanding and implementing a quality management system for ICT successfully, and thus "quality" must be an integral part of the way the business is designed.

Therefore, the following section will focus on total quality management (TQM) as an approach to systematic quality management implementation, because it assumes that most problems are systemic rather than caused by human error. The main philosophers of TQM, such as Crosby, Deming, Feigenbaum, Juran and Taguchi, are introduced next.

3.3 TOTAL QUALITY MANAGEMENT (TQM)

TQM is not another passing fashion, because it both meets the interests of employees while providing top management with an effective way of organising (Hill, 2008/2009). According to Claver and Tari (2007), TQM may improve customer results, people results, society results and quality performance. TQM factors relate to training and specialists training is to be the most significant predictors of quality outcomes.

Total quality is defined as an approach of doing business that attempts to maximise the competitiveness of an organisation through continual improvements in the quality of its products, services, people and environment by emphasising quality principles (Goetsch & Davis, 2002).

Nowadays, competitive organisations are continuously improving their processes towards TQM. Customer demands are being handled using TQM, which is an ever-improving system

for integrating various organisational elements into the design, development and manufacturing efforts, thereby providing cost-effective products or services that are fully acceptable to the ultimate customer (Kerzner, 2006: 833).

TQM, by definition, encompasses every aspect of the business or organisation, not just the systems used to design, produce and deploy its products or services. This includes all the support systems such as human resources, finance and marketing. TQM involves every function and level of the organisation, from top to bottom (Goetsch & Davis, 2002).

According to BS.4778: Part 2 (1991), TQM is:

"A management philosophy embracing all activities through which the needs and expectations of the customer and the community, and the objectives of the organisation are satisfied in the most efficient and cost effective way by maximizing the potential of all employees in a continuing drive for improvement."

According to Koehler and Pankowski (1996: 15), TQM is a management system that embraces a set of values and principles that are intended to allow all associates to constantly advance organisational processes with the objective of meeting or exceeding customer expectations. For several decades, the quality circles, audits and systems have been integral elements of organisations in the corporate sector (Koehler & Pankowski, 1996: 15).

TQM originated during the 1930s with theorists such as Edward Deming. The system was implemented by Japanese industry after World War II and their success in manufacturing quality products caused many American, latterly worldwide, companies to investigate TQM and eventually embrace it. Although the commonly acknowledged view is that quality is a crucial factor in the long-term success of an organisation, failures in TQM initiatives are reported to be extremely high in organisations, thus hindering the realisation of TQM benefits (Macleod & Baxter, 2001: 392–403).

Sadly, it is evident that not every solution adopted is well implemented. For example, a solution that is adopted with the intent to make an organisation more efficient, productive and

cost-effective can result in an implementation of the exact opposite by wasting time, money and valuable manpower. Hence, it is important to emphasise QA in every system acquisition in its early stages of development.

In order to understand the notions of TQM, a short overview of the four best-known quality management experts, Crosby (1979), Deming (1982), Feigenbaum (1983) and Juran (1988), is provided.

3.3.1Crosby

Crosby's approach stresses that the cost of poor quality should include all the costs of not doing the job right the first time, such as scrap, rework, lost labour hours and machine hours, customer ill will and lost sales, and warranty costs. Crosby further urges that organisations should strive for zero defects (Schwalbe, 2007: 332). Crosby identifies a period of enlightenment during which management becomes attuned to the importance of quality (Foster, 2007: 50). In his approach, Crosby provides the following Fourteen-Step Quality Improvement Programme (Crosby, 1979), which focuses on how to change the organisation. This is demonstrated in the Table 3.2 below:

	Crosby's Fourteen-Step Quality Improvement Programme
Step 1	Make it clear that management is committed to quality.
Step 2	Form quality improvement teams with representatives from each department.
Step 3	Determine where the current and potential quality problems lie
Step 4	Evaluate the cost of quality and explain its use as a management tool
Step 5	Raise quality awareness and personal concerns of all employees
Step 6	Take actions to correct problems identified through previous steps
Step 7	Establish an ad hoc committee for the zero-defects programme
Step 8	Train supervisors to actively carry out their part of the quality improvement
	programme
Step 9	Hold a "zero defects day" to let all employees realise that there has been a change
Step 10	Encourage individuals to establish improvement goals for themselves and their
	teams

Table 3-2: Crosby's fourteen steps

Step 11	Encourage employees to communicate the obstacles they face in attaining their	
	improvement goals to management	
Step 12	Recognise and appreciate those who participate	
Step 13	Establish quality councils to communicate on regular basis	
Step 14	Do it all over again to emphasise that the quality improvement programme never	
	ends.	

Source: Foster (2007: 50); Schwalbe (2007: 332)

Another philosophy is Deming's approach to TQM, which is discussed next.

3.3.2Deming

Deming's philosophy (1982) is that quality improves the productivity and competitiveness of an organisation.

Although Deming is best known for his emphasis on the management of a system for improving quality, his thinking was based in the use of statistics for continual improvement (Foster, 2007: 37). Deming's approach stresses that consumers are well served by insisting that service and product providers deliver high quality (Foster, 2007: 38). His mantra was "continual never-ending improvement", meaning that the goal of higher levels of quality would perhaps never be completely met, but organisations would continually exercise themselves to improve (Foster, 2007: 38). Hence, quality improvement is referred to as a journey where the elusive destination is never reached.

Deming advocates the measurement of quality by direct statistical measures of manufacturing performance against specification. Table 3–3 summarises his fourteen-point approach (Deming, 1986: 45) to improving quality.

Table 3-3: Deming's fourteen points for management

	Deming's Fourteen Points for Management
1	Create constancy of purpose towards improvement of product and service, with the aim to become
	competitive, stay in business and provide jobs.

2	Adopt the new philosophy - we are in a new economic age. Western management must awaken to the
	challenge, learn its responsibilities and take on leadership for future change.
3	Cease dependence on inspection to achieve quality. Eliminate the need for inspection on a mass basis
	by building quality into the product in the first place.
4	End the practice of awarding business on the basis of price tag. Instead, minimise total cost. Move
	towards a single supplier for any one item in a long-term relationship of loyalty and trust.
5	Improve constantly and forever the system of production and service, to improve quality and
	productivity, and thus constantly decrease costs.
6	Institute training on the job.
7	Institute leadership (see point 12 below): the aim of supervision should be to help people, machines
	and gadgets to do a better job. Supervision of management, as well as supervision of production
	workers, is in need of a management overhaul.
8	Drive out fear so that everyone may work effectively for the company.
9	Break down barriers between departments. People in research, design, sales and production must
	work as a team to foresee problems of production and problems in use that may be encountered with
	the product or service.
10	Eliminate slogans, exhortations and targets for the workforce, which ask for zero defects and new
	levels of productivity. Such exhortations only create adversarial relationships, as the bulk of the causes
	of low quality and low productivity belong to the system and thus lie beyond the power of the workforce.
11(a)	Eliminate work standards (quotas) on the factory floor; substitute leadership instead.
11(b)	Eliminate management by objectives, by numbers and by numerical goals; substitute leadership
	instead.
12(a)	Remove barriers that rob the hourly worker of his or her right to pride of workmanship. The
	responsibility of supervisors must be changed from sheer numbers to quality.
12(b)	Remove barriers that rob people in management and in engineering of their right to pride of
	workmanship. This means, inter alia, abolishing the annual or merit rating and management by
	objectives.
13	Institute a vigorous programme of education and self-improvement.
14	Put everybody in the company to work to accomplish the transformation. The transformation is
	everybody's job.

Source: Foster (2007: 38); Schwalbe (2007: 331)

3.3.3 Feigenbaum

Feigenbaum's (1983) philosophy asserts that the responsibility for quality rests with the people who do the work. His primary contribution to quality thinking is his assertion that the

entire organisation should be involved in improving quality (Foster, 2007: 48–49). He proposes a three-step process to quality improvement (Foster, 2007: 49):

- 1. Quality leadership: leadership is the motivating force for quality improvement.
- 2. Quality technology: includes statistics and machinery that can be used to improve technology.
- 3. Organisational commitment: includes everyone in the quality struggle.

Senior management involvement and commitment to incorporating quality into their management practice is crucial to the successful installation of Feigenbaum's total quality system (1983). He further advocates that management should realise that quality does not mean only that customer problems have to be fixed faster; it means that quality leadership is essential to a company's success in the marketplace.

In his approach, Feigenbaum (1983) takes a strong stance on a financial approach to quality management. He believes that the effective installation and management of a quality improvement process represents the best return-on-investment opportunity for many companies in today's competitive environment.

Feigenbaum states (1983: 55) that management should commit itself to the following three criteria:

- strengthening the quality improvement process itself;
- making sure that quality improvement becomes a habit;
- managing quality and cost as complementary objectives.

As Feigenbaum does not espouse fourteen points or steps like Deming and Crosby, it is obvious that his approach is significantly different from theirs. It focuses on managerial experience and knowledge know-how.

Another quality philosopher who deserves consideration for his efforts in a TQM systems approach is Juran.

3.3.4 Juran

Juran promotes the view that organisational quality problems are largely the result of insufficient and ineffective planning for quality. He advocates that organisations should revise strategic planning processes and achieve mastery over them (Foster, 2007).

Juran stresses the importance of top management commitment to continuous product quality improvement (Schwalbe, 2007: 331). In his work, he includes the Juran trilogy: quality improvement, quality planning and quality control. He further stresses the difference between organisational viewpoints on quality to those of clients, where organisations focus on conformance to requirements, while customers focus on fitness for use.

According to Dale (1994: 18), Juran has perhaps made a greater contribution to the quality management literature than any other quality professional. Like Deming, Juran had an influence on the development of quality management in Japanese companies. While Deming provided advice on statistical methods from the late 1940s onward, Juran, in the mid-1950s, focused on the role of senior people in quality management.

Dale (1994: 19) further states that part of Juran's hypothesis is that companies must reduce the cost of quality. This is dramatically different from Deming's approach, which ignores the cost of quality, while Juran, like Crosby and Feigenbaum, claims that reducing it is a key objective. A ten-step plan summarises Juran's approach in Table 3.4 (Schwalbe, 2007: 332):

The Juran's Ten – steps to quality improvement		
1	Build awareness of the need and opportunity for improvement.	
2	Set goals for improvement.	
3	Organise to reach the goals.	
4	Provide training.	
5	Carry out projects to solve problems.	
6	Report progress.	
7	Give recognition.	
8	Communicate results.	

Table 3-4: The Juran method

9	Keep the score.
10	Maintain momentum by making annual improvement part of the regular system and
	processes of the company.

Source: Kerzner (2006: 836); Schwalbe (2007: 332)

Juran (1988) defines quality as "fitness for use", which he decomposes into the quality of design, quality of conformance, availability and field service. The goals of Juran's approach are increased conformance and decreased cost of quality, and annual goals are set in the objective-setting phase of the programme.

Juran's allocation of responsibility among the workforce is different from Deming's. He places primary responsibility with quality professionals who serve as consultants to top management and employees. The quality professionals design and develop the programme and do most of the work. While granting the importance of top management support, Juran (1988) places more of the quality leadership responsibility on middle management and quality professionals. The role of the workforce is mainly to be involved in quality improvement teams.

In addition to the approaches and philosophies of these four experts, the Japanese quality management culture is widely publicised. In the mid-to late 1980s, the work and ideas of a number of Japanese quality experts were published in English. The ideas of Imai, Ishikawa and Shingo are all being applied in the West, however, it is the work of Taguchi which is the best known and is discussed next.

3.3.5 Taguchi

The key concepts of the Taguchi method are that quality should be designed into the product and not inspected into it, and that quality is best achieved by minimising deviation from the target value. The Robust Design Methods Taguchi (1986) focus on eliminating defects by substituting scientific inquiry for trial-and-error methods (Schwalbe, 2007: 333).

According to Foster (2007: 51), quality is delivered if a product or service performs its intended function throughout its projected life under reasonable operating conditions without

harmful side effects. Taguchi measures service quality in terms of loss to society if the service is not performed as expected .

Taguchi (1986: 45) defines quality as: "The quality of a product is the loss imparted to society from the time the product is shipped." Among the losses he includes are consumer dissatisfaction, warranty costs, loss of reputation and, ultimately, loss of market share.

Taguchi (1986: 46) further maintains that a product does not start causing losses only when it is out of specification, but when there is any deviation from the target value. According to Foster (2007: 51), any deviation from the target product or service specification results in loss to society. According to Dale (1994: 24), loss to society can be represented by a quadratic function, that is, the loss increases as the square of the deviation from the target value. This leads to the important conclusion that quality (as defined by Taguchi) is most economically achieved by minimising variance rather than by strict conformance to specification. In summarising Taguchi's approach on quality improvement, Kerzner (2006: 840) presents the following concepts within this philosophy:

- Quality should be designed into the product and not inspected into it.
- Quality is best achieved by minimising the deviation from a target.
- The cost of quality should be measured as a function of deviation from the standard and the losses should be measured system-wide.

It is evident that there is no single or ideal way of assuring the quality of an organisation's products or services. What matters is that quality improvement does occur, is cost-effective and is never-ending. It is seen that quality can be viewed differently but it is wise for organisations to identify what quality means to their clients to satisfy their needs. These approaches further reveal the importance of management involvement and commitment to quality improvement activities while taking into account the role of the workforce to the extent that quality should be adopted as organisational culture, in order to eliminate the costs associated with quality.

The use of these "principles" may vary considerably from one company to the next. It is important to acknowledge that companies are at various stages of maturity in implementing

this kind of system. Some companies may be "pushing the envelope" and have succeeded in using a systems approach to integrate their business and quality systems. Others may have no quality system at all or an older compliance-oriented ISO 9000 QMS that is not well oriented with assisting to drive business results (Jacobs, 2003).

In order to introduce quality in organisations, Juran's (1974) quality improvement approach advocates a project-by-project implementation and a breakthrough sequence. He cautions against shortcuts from symptom to solution without the thorough elicitation and elimination of the actual cause. It is, therefore, in this context that the next section discusses quality on a project basis and assumes the importance and applicability of project quality management in enforcing TQM. This section discussed the notions of QA, the ISO standards introducing quality principles, and the models and frameworks that can be used for quality improvement.

3.4 QUALITY MANAGEMENT IN PROJECTS

In order to recognise project quality management, it is important to firstly understand the term "project". According to Schwalbe (2007: 4), a project refers to a provisional attempt undertaken to produce a unique product, service or result. Turner (2009) adds to this by defining a project as an effort in which resources are organised to undertake a unique scope of work of given specification within constraints of cost and time to deliver a beneficial change which is defined by quantitative and qualitative objectives.

A quality programme within the system acquisition project can be realised by enforcing quality in the project management methodology followed during the acquisition process.

Project management is the discipline of organising and managing resources so that they deliver all the work required to complete a project within a defined scope, quality, and time and cost constraints (PMBOK, 2004). However, these are not sufficient without a quality product (PMBOK, 2004). It is undisputable that IT projects fail to achieve their goals, and it is common for the predominant causes of these problems to result to poor quality from the initiation of the project. Thus, focusing on enhancing quality is critical for every project to

prevent failures and revenue loss. Most organisations, sadly, have not yet realised this crucial factor for project success;. They are struggling to acquire solutions that support and enhance, rather than hinder, their business needs and their customer expectations. This is a vicious circle which results in revenue loss in many organisations, but they will continue to be trapped in such a situation until they recognise the importance of quality as a critical contributor to success.

From the published literature reviewed (Tierstein & Benoit, 2005; Hoffman, 1993; Cavano & McCall, 1978; Harding Roberts, 2005; Taylor, 2002; Ward, 2007) on the problems experienced during projects and their quality initiatives, the following are the common problems identified:

- Poor documentation and non-conformance to standards has led to the majority of projects defects being found during the verification phases.
- The lack of a traceability requirement leads to higher solution failures.
- Perceptions, such as excessive paperwork and cumbersome standards documents, lead to ignorance of quality initiatives.
- The selection of inappropriate standards, principles and solution acquisition methodologies.
- Unrealistic cost estimates, leading to overrun.
- The poor performance of implemented systems just after their implementation.
- Lack of quality definition accepted upfront.
- Lack of project evaluation and knowledge base.
- Limited time invested in planning phase.
- Limited leadership involvement in the project.
- Poor quality planning and QA, leading to late identification of risks.
- Lack of accountability.
- Poor analysis and design for customer requirements and solutions to fulfil their needs and exceed their expectations.

It is evident that the effective adoption of an appropriate software development methodology that has good support and structure in terms of quality assurance activities becomes vital for successful systems acquisition projects. In order to ensure project success, organisations need to focus on the scope, time and cost of the project, and enforce quality throughout the project lifecycle. According to Langerman (2008), system implementation projects fail largely due to a lack of understanding of project objectives and user expectations. Often this is the result of a lack of QA throughout the project stages. To become superior in quality it is imperative to apply the following two actions (Gryna *et al.*, 2007: 265):

- Develop technologies that meet the customer needs.
- Stimulate a "culture" throughout the organisation that continuously views quality as a primary goal. Quality culture is a pattern of human habits, beliefs, values and behaviour concerning quality.

According to Schwalbe (2007: 307), many IT projects fail as the team focuses only on meeting the scope, time and cost requirements as the criteria for project success. However, to ensure project success, quality must be on an equal level with scope, time and cost. If the stakeholders are not satisfied with the quality of the project, tradeoffs will be made in terms of its scope, time or cost . Meeting the scope, time or cost is not sufficient to obtain stakeholder satisfaction, quality products or services have to be delivered. In order to manage quality in projects properly, the project team must incorporate quality management processes in their systems development methods. These project quality management processes are discussed.

3.4.1 Project quality management key processes

The main principle of project quality management is to ensure the project will meet or exceed stockholders' needs and expectations. Thus, the project team must develop a good relationship with key stakeholders to understand what quality means to them. One of the causes of poor project evaluations is that the project focuses only on meeting the written requirements for the main outputs and ignores other stakeholder needs and expectations for the project (PM4DEV, 2008; Schwalbe, 2007: 307–314). The literature reveals that there are

three main project quality management processes (Foster, 2007: 24; Schwalbe, 2007: 307–314; PMBOK, 2004; PM4DEV, 2008):

- **Quality planning.** Identify which quality standards are relevant to the project and how to satisfy them; incorporate quality into a project design.
- **Quality control.** Monitor specific project results to ensure that they comply with the relevant quality standard while identifying ways to improve overall quality.
- **Quality assurance (QA).** Evaluate overall project performance periodically to ensure that the project will satisfy the relevant quality standards. It entails taking responsibility for quality through the project life cycle.

These processes are discussed.

3.4.1.1 Quality planning

According to PMBOK (2004), quality planning is the process of identifying quality requirements and/or standards for the project and product, and documenting how the project will demonstrate compliance. The project quality plan describes all the quality definitions and standards relevant to the project (PM4DEV, 2008). These include the definition of the quality characteristics, as ISO 8402 makes it clear that quality is determined by the presence or absence of these attributes, with the implication that these are specific attributes that can be designed into the product. When combined with an ISO 9001-compliant quality process, the natural interpretation is that quality is specified and evaluated at the level of product attributes, which are defined as follows (ISO/IEC FCD 9126-1):

- **Functionality** the capability of the software to provide functions which meet stated and implied needs when the software is used under specified conditions.
- Reliability the capability of the software to maintain its level of performance when used under specified conditions.
- Usability the capability of the software to be understood, learnt, used and liked by the user when used under specified conditions.

- Efficiency the capability of the software to provide the required performance relative to the amount of resources used under stated conditions.
- Maintainability the capability of the software to be modified. Modifications may include corrections, improvements or adaptations of the software to changes in environment, and in requirements and functional specifications.
- Portability the capability of software to be transferred from one environment to another.

The following are the typical outputs of the quality planning process (PMBOK, 2004):

- Quality management plan. This describes how the project management team will implement the organisation's quality policy. It is a component or a subsidiary of the project management plan. It provides the input to the overall project management plan and includes quality control, QA and continuous process improvement approaches for the project.
- **Quality metrics.** This is an operational definition that describes, in very specific terms, a project or product attribute and how the quality control process measures it.
- *Quality checklists*. This is a structured tool, usually component-specific, used to verify that a set of required steps has been performed. Checklists range from simple or complex.

3.4.1.2 Quality control

Quality control is the process of monitoring and recording the results of executing the quality plan activities to assess the performance and recommend necessary changes. Quality control is performed throughout the project and quality standards include project processes and product goals. Project results include deliverables and project management results, such as cost and schedule performance (PMBOK, 2004). Quality control is the process that monitors specific project results to determine whether they comply with the relevant standards and it identifies different approaches to eliminate the causes for unsatisfactory performance

(PM4DEV, 2008). Although the main goal of quality control is to improve quality, the main outcomes of this process include the following (Schwalbe, 2007: 313):

- Acceptance decisions determine if the product or service produced will be accepted or rejected.
- Rework is the action taken to bring the rejected product or service into compliance with the requirements, quality specifications or stakeholder expectations. Rework often results in changing requests and validating defect repair resulting from recommended defect repair or corrective or preventative actions. Rework is expensive; hence, the project team must make every effort to do a good job in quality planning and QA to avoid the need for rework.
- Process adjustments involve correcting or taking the necessary steps to prevent further quality problems or defects based on quality control measurements. Process adjustments are identified using quality control measurements, and they often result in updates to the quality baseline and project plan.

To perform quality control, several tools and techniques are used, such as the cause-andeffect diagram, control charts, flowcharting, histograms, Pareto charts, run charts, and scatter diagrams. These are referred to as the "Seven Tools for Quality" (PMBOK, 2004; Schwalbe, 2007: 314).

3.4.1.3 Quality assurance (QA)

There is currently limited work being done emphasising the QA processes of project quality management; hence, the focus of this study. Accordingly, it is important for the various concepts of QA are firstly defined before they are discussed as a process within project quality management.

3.4.1.3.1 Notions of quality assurance

According to Kerzner (2006: 846), QA is the collective term for the formal activities and managerial processes that attempt to ensure that products and services meet the required

quality level. It includes efforts that are external to these processes that provide information for improving the internal processes. It is the QA function that attempts to ensure that the project scope, cost and time functions are fully integrated (Kerzner, 2006: 846). The PMBOK refers to QA as the management section of quality management. This is the area where a project manager can have the greatest impact on the quality of the project, by establishing administrative processes and procedures necessary to ensure and prove that the scope statement conforms to the actual requirements of the customer.

QA means "the sum of activities that assure the quality of products and services at the time of production or delivery. QA procedures are frequently applied only to the activities and products associated directly with the goods and services provided to external customers" (SAQA, 2001: 6).

According to Foster (2007: 25), QA refers to activities associated with guaranteeing the quality of a product or service. Often these activities are design oriented. The QA includes all the activities in solution acquisition projects, from conceptualisation, design, development, production, installation and servicing to documentation. Within the QA discipline, "fit for purpose" and "do it right the first time" quotes have emerged. QA consists of the quality of raw materials, assemblies, products and components; services related to production and management; production; and inspection processes (Management Update, 2007).

QA can have the greater impact on the project quality. QA involves continuous quality improvement and this has been seen as an important factor for implementation success, to the extent that some companies have established a department to focus on this area (Langerman, 2008). However, in many companies, the QA (note the misuse of the word "assurance" here) department still perform the in-process and final inspection of a product. In this scenario, the responsibility for quality lies with the quality department. However, by the time the quality department inspects the product, the quality is built in or it is not built in and, at this point, it is too late to add quality (Foster, 2007: 39). Deming's alternative is quality at the source. This means that all workers are responsible for their own work and perform the

needed inspection at each stage of the process to maintain process control. However, this is only possible if management trusts and trains its workers (Deming in Foster, 2007: 39).

Quality experts agree that quality can be assured during the design phase. Although statistical inspection is an important approach to improving quality, it is inherently reactive. Therefore, efforts must be invested in designing products, services and processes so that they are consistently of high quality (Foster, 2007: 57). By focusing on issues such as maintainability, assembly, reliability, product traceability, it is possible to continuously improve the ability to make things (Foster, 2007: 225; Gryna *et al.*, 2007).

QA is concerned with the consistency, readability, usability, maintainability, reliability and other attributes of the completed system and the work products produced throughout the project life cycle. Quality is assured through multiple review points with the customer to identify errors, inconsistencies, misunderstandings and omissions in each interim work product (Nabrzyski, 2002). According to Townsend (1997: 113), QA is the critical process by which the quality improvement process is confirmed. He further states that QA needs to go beyond this to assure that the outcomes are reached (Townsend, 1997: 113).

QA approaches can be external and imposed or internally generated. They are an attempt to ensure that customer (community) needs and wants are being met (Jacobs, 2003). QA gives sufficient feedback and implies some form of control. Jonathan (2000:46) states that QA is seen as having four components:

- Everyone in the institution has a responsibility for maintaining the quality of a product or service.
- Everyone in the institution has a responsibility for enhancing the quality of the product of service.
- Everyone in the institution understands takes and uses ownership of the systems that are in place for maintaining and enhancing quality.
- The institution satisfies itself that it has effective structures and mechanisms in place so that continual quality improvement can be guaranteed.

3.4.1.3.2 QA as a project quality management process

QA is the process of auditing the quality requirements and the results from quality control measurements to ensure that appropriate quality standards and operational definitions are used. QA is an execution process that uses data created during quality control (PMBOK, 2004), and it is the activity of providing evidence to establish confidence that quality requirements will be met. ISO defines QA as all the planned and systematic activities implemented within the quality system and demonstrated as needed to provide adequate confidence that an entity will fulfil requirements for quality (Gryna *et al.*, 2007: 519). Many QA activities provide protection against quality problems by early warnings. These include activities such as the following (Gryna *et al.*, 2007: 519):

- **Quality audit** is an independent review conducted to compare some aspects of quality performance with a standard for that performance.
- Quality assessment (evaluation) refers to the total spectrum of quality activities
 often including managerial matters such as cost of poor quality, standing in the
 marketplace, and quality culture. ISO defines a quality audit as a systematic and
 independent examination to determine whether quality activities and related results
 comply with planned arrangements and whether these arrangements are implemented
 effectively and are suitable for achieving objectives.
- **Product audit** is the review of the physical product, while a quality audit is the review of an activity. It is an independent evaluation of a product's quality to determine its fitness for use and conformance to specification.

It is apparent that QA can be defined as all the activities that contribute to defining, designing, assessing, monitoring, and improving the quality of the system. It is evident that QA activities include several elements that have some form of review, inspection, approval and testing. In addition, QA provides an umbrella term for continuous process improvement, which is an iterative means for improving the quality of all processes. Continuous process improvement reduces waste and eliminates activities that do not add value. This allows processes to operate at increased levels of efficiency and effectiveness.

To assist organisations to ensure quality in their projects QA methodologies, principles, models and standards are available. According to SAQI (2007), the quality principles and standards are made available to form the basis of implementing a QA methodology in an organisation. However, there is no single methodology or standard that can be applied as is. Therefore, it is important that organisations decide on the appropriate standards to adopt, and develop their own QA methodology, both based and implemented on those standards. Thus, benchmarking becomes important during quality improvement projects by comparing the project practices or product characteristics against those of other projects or products within or outside the performing organisation (Schwalbe, 2007: 312).

The following sections highlight QA institutes, standards, models/frameworks and methodologies for system acquisition projects that are applicable to this study.

3.5 THE INTERNATIONAL ORGANISATIONS FOR QUALITY STANDARDS

There are a variety of organisations for standards that are to provide guidance to organisations about the implementation of quality, and these organisations help to ensure that standards are kept up to date (Jacobs, 2003). In the following subsections, some of the different organisations for quality standards are discussed.

3.5.1 The International Organization for Standardization (ISO)

The ISO is the world's largest developer and publisher of International Standards (ISO, 2009). It is a network of national standards institutes in 158 countries, one member per country, with a Central Secretariat in Geneva, Switzerland that coordinates the system (ISO, 2009).

The ISO is a non-governmental organisation and its members are not delegations of national governments (ISO, 2009). However, the ISO occupies a special position between the public and private sectors (ISO, 2009), because most ISO member institutes are part of a government structure or are mandated by their government and those members that are in

the private sector, having been set up by national partnerships of industry associations (ISO, 2009).

Therefore, the ISO is proficient to operate as an association in which consent can be accomplished on solutions that fulfil both the requirements of business and the broader needs of society (ISO, 2009). The ISO provides technological, economic and societal benefits as outlined (ISO, 2009):

- For businesses. The extensive acceptance of international standards means that suppliers can base the development of their products and services on specifications that have wide acceptance. This, means that businesses using these international standards are free to compete in more global markets.
- *For customers.* The global compatibility of technology that is accomplished when products and services are based on international standards allows customers ranges of choice of offers, and they benefit from the effects of competition among suppliers.
- **For governments.** International standards provide the technological and scientific bases underpinning health, safety and environmental legislation.
- For trade officials. Negotiating the emergence of regional and global markets, international standards create "a level playing field" for all competitors in those markets.
- For developing countries. International standards that represent an international consensus on what "state of the art" is, constitute an important source of technological know-how. By defining the characteristics that products and services are expected to meet in export markets, developing countries are given a basis for making the right decisions when investing their scarce resources.
- **For consumers.** Conformity of products and services to international standards provides assurance about their quality, safety and reliability.
- **For everyone.** International standards contribute to the quality of life in general by ensuring that the transport, machinery and tools used are safe.
- *For the planet.* International standards for air, water and soil quality, and for the emissions of gases and radiation, contribute to efforts to preserve the environment.

Although ISO standards are the most extensively used standards, not all the standards or solution are "one size fit all". As a result ,other countries have formed their own quality institutes to assist local organisations in implementing quality standards. The following subsection focuses on the SAQI.

3.5.1.1 South African Quality Institute (SAQI)

The SAQI is a national body that coordinates quality efforts in South Africa since its registration in 1993. The Institute acts as a global bridge to enable business links and the exchange of useful information. It acts as a medium and promoter in arranging quality events within reach of the South African public. SAQI's vision is to be a "driver of quality, contributing towards the global competitiveness of the South African economy and the region as a whole" (SAQI, 2009).

The SAQI's mission is described by the following (SAQI, 2009):

- Play a leading role in establishing and sustaining a national quality infrastructure.
- Create a national awareness of quality.
- Unify the quality profession into a body of knowledge that is recognised as the national benchmark of quality in all fields.
- Represent South African quality abroad and to help with the improvement of Africa's quality infrastructure.

The SAQI defines quality as representing terms such as inspection, process control, auditing, standards and ISO 9000. Although quality includes these principles, it includes, for example, management systems and continuous improvement, customer satisfaction and market focus, teamwork and the wellbeing of employees.

These principles are all critical to success, whether in healthcare, education, manufacturing, the service industry or the public sector. Quality is the critical success factor in competitiveness, especially when doing business internationally (Jacobs, 2005). The SAQI

provides direction in establishing and maintaining quality principles in organisations by forming an "umbrella" body that coordinates the national quality effort.

The following subsection looks at the American Society for Quality (ASQ).

3.5.1.2 American Society for Quality (ASQ)

The ASQ is the global leading authority on quality and promotes the Six Sigma Quality Standard. This organisation is committed to the advancement of learning, quality improvement and knowledge exchange to improve business results and to create better workplaces and communication worldwide (ASQ, 2009).

The ASQ was established in 1946 and supports its members by providing a wide range of resources. Globally, the ASQ has formed relationships with non-profit organisations with comparable missions and principles and by forming collaborative efforts to meet the quality needs of companies, individuals and organisations worldwide.

Since 1991, the ASQ has administered the United States's premier quality honour, namely the Malcolm Baldrige National Quality Award, which annually recognises companies and organisations that have achieved performance excellence.

The ASQ has been at the forefront of the quality movement for more than 60 years and has played a crucial role in upholding quality standards from the past, while championing continued innovation in the field of quality. The following subsection deals with the EFQM.

3.5.1.3 European Foundation of Quality Management (EFQM)

EFQM is a non-for-profit membership foundation that, for over 20 years has been sharing what works between organisations as a way to help them implement their strategies, by extracting outstanding approaches and engaging with executives and front-line managers (EFQM, 2009). It was founded in 1989 by the chief executive officers (CEOs) of prominent

European businesses and is now the hub of excellent, globally-minded organisations of all sizes and sections.

The EFQM promotes the EFQM Excellence Model, which is a framework for organisational management systems designed to help organisations towards being more competitive (EFQM, 2003). This framework is discussed in detail in this research (*cf* 3.4.4.1).

The following subsection focuses on an international quality institute, the Chartered Quality Institute (CQI).

3.5.1.4 Chartered Quality Institute (CQI)

The Institute of Quality Assurance (IQA) officially became the CQI on 18 January 2007. The CQI is the only chartered professional body dedicated entirely to quality. It is convinced that the efficiency and competitiveness of industry and commerce can be improved by making quality the top priority and its vision is to place quality at the heart of every organisation (CQI, 2009).

There are several institutes aimed at humanising quality adoption to meet organisational and customer goals. These institutes are knowledge-based forums for sharing quality-related knowledge for the good of industry, businesses and individuals (Jacobs, 2003). The following section discusses quality standards.

3.6 ISO STANDARDS

Standards make a large and positive contribution to most aspects of people's lives. They ensure the desirable characteristics of products and services exist, such as quality, environmental friendliness, safety, reliability, efficiency and interchangeability – and at an economical cost (ISO, 2009). Although standards have a great impact on all aspects of life, when everything is going as expected, standards tend to be ignored or their role t not fully recognised. However, when there are no standards, it is soon realised and their role and

contribution to most aspects of life is recognised and their importance is realised. For example, as purchasers or users of products, the consumer is soon aware when they turn out to be of poor quality, do not fit, are incompatible with equipment already owned, are unreliable or dangerous. When products meet expectations, it is taken for granted. The role played by standards in raising levels of quality, safety, reliability, efficiency and interchangeability, and in providing such benefits economically in un-noticed (ISO, 2009).

In the paragraphs that follow, the different quality standards will be briefly discussed.

3.6.1 ISO 9000

ISO 9000 deals with quality management systems; with the design, development, purchasing, production, installation, and the servicing of products and services (Goetsch & Davis, 2002).

In response to the need to harmonise dozens of national and international quality standards that existed throughout the world in the 1970s and 1980s, the ISO formed Technical Committee 176 (TC 176), an international team representing 75 nations. Its objective was to develop a universally accepted set of quality standards. This became known as the ISO 900 series of standards, which were first released in 1987, and after updates by TC 176, were finally released in 1994 (Goetsch & Davis, 2002; ISO, 2006).

Originally, the reason for creating the ISOP9000 was to replace the dozens of national and international quality standards within one single family of standards universally recognised and used. The object was to enable organisations to consistently produce products or services that meet the requirements of customers and live up to the organisations stated intentions. In IN 2000, the objective was broadened to include consistency in products, meeting customer and regulatory requirements, and having systems that addresses customer satisfaction and continual improvement and prevent nonconformity (Goetsch & Davis, 2002). The evolution of ISO 9000 has aligned it more closely with TQM philosophy.

The ISO 9000 standard is among the ISO's most widely known standards. ISO 9000 has become an international reference for quality requirements in business-to-business dealings (ISO, 2006).

The vast majority of ISO standards are highly specific to a particular product, material or process. However, the reason why the ISO 9000 standard has earned ISO a worldwide reputation is because it is known as a generic management system standard. Generic means that the same standard can be applied to any organisation, large or small; whatever its product or service; in any sector of activity; and whether it is a business enterprise, a public administration or a government department. Generic signifies that no matter what the organisation is or does, if it wants to establish a quality management system, then such a system has to have a number of essential features, which are spelt out in ISO 9000. The management system refers to what the organisation does to manage its processes or activities (ISO, 2006).

The ISO 9000 family is primarily concerned with quality management. This means what the organisation does to fulfil the following:

- the customer's quality needs;
- the applicable regulatory requirements;
- Aim to enhance customer satisfaction;
- achieve continual improvement of its performance in pursuit of these objectives.

The following subsection specifically focuses on the ISO 9000:2000 standards as they specify requirements for a quality management system for organisations to consistently provide products or services that meet customer and applicable regulatory requirements and aim to enhance customer satisfaction. This standard is important to this study, which seeks to establish a management system that provides confidence in the conformance of products or services to established or specified requirements by adopting QA.

3.6.1.1 ISO 9000:2000

The ISO 9000 family of international quality management standards and guideline that have earned a global reputation as the basis for establishing quality management systems.

ISO 9001:2000 specifies the requirements for a quality management system for any organisation that needs to demonstrate its ability to consistently provide products that meet customer and applicable regulatory requirements and aim to enhance customer satisfaction (ISO, 2006). ISO 9001:2000is organised in a user-friendly format with terms that are easily recognised by all business sectors. The standard is used for certification or registration and contractual purposes by organisations seeking recognition for their quality management system.

The greatest value is obtained when the entire family of standards is used in an integrated manner. It is suggested that, beginning with ISO 9000:2000, an organisation adopt ISO 9001:2000 to achieve the first level of performance. The practices described in ISO 9004:2000 may then be implemented to make the quality management system increasingly effective in achieving an organisation's own business goals. ISO 9001:2000 and ISO 9004:2000 have been formatted as a consistent pair of standards to facilitate their use. Using the standards in this way will enable their integration into other management systems and many sector-specific requirements, while assisting in gaining recognition through national award programmes.

ISO 9001:2000 is used if an organisation is seeking to establish a management system that provides confidence in the conformance of products to established or specified requirements. It is the only standard in the ISO 9000 family against which the requirements of a quality system can be certified by an external agency. The standard that the word "product" applies to includes services; processed material; as well as hardware and software intended for, or required by, customers (ISO, 2006).

There are five sections in the standard that specify the activities that need to be considered when implementing a system. The organisation will describe the activities it uses to supply its products and may exclude the parts of the product realisation section that are not applicable to its operations. The requirements in the other four sections, namely quality management system, management responsibility, resource management and measurement, and analysis and improvement, apply to all organisations.

Together, the five sections of ISO 9001:2000 define what an organisation should do consistently to provide products that meet customer and applicable statutory or regulatory requirements. In addition, organisations will seek to enhance customer satisfaction by improving their quality management system (ISO, 2006).

ISO 9004:2000 is used to extend the benefits obtained from ISO 9001:2000 to all parties that are interested in, or affected by, the business operations. Interested parties include employees, owners, suppliers and society in general (ISO, 2006).

ISO 9001:2000 and ISO 9004:2000 are harmonised in structure and terminology to assist organisations to move smoothly from one to the other. Both standards apply a process approach. Processes are recognised as consisting of one or more linked activities that require resources and must be managed to achieve predetermined output. The output of one process may directly form the input for the next process, and the final product is often the result of a network or system of processes (ISO, 2007a). The eight quality management principles stated in ISO 9000:2000 and ISO 9004:2000 provide the basis for the performance improvement outlined in ISO 9004:2000. These are discussed in the next subsection. The nature of a business and the specific demands it faces will determine how these standards are applied to achieve the organisation's objectives.

The following subsection focuses on the ISO 9000:2000 quality management principles that support the ISO 9000:2000 standard.

3.6.1.2 ISO 9000:2000 quality management principles

ISO9000:2000 has made a giant leap in comparison, especially in the area of continual improvement, which has gone from just cursory treatment to being a firm requirement. In addition, the standard now incorporates the eight quality management principles that come directly from TQM (Goetsch & Davis, 2002).

This subsection introduces the eight quality management principles on which the quality management system standards of the revised ISO 9000:2000 series are based. Senior management can use these principles as a framework to guide their organisations towards improved performance. The principles are derived from the collective experience and knowledge of the international experts who participate in the ISO Technical Committee (ISO/TC) 176, Quality Management and Quality Assurance, which is responsible for developing and maintaining the ISO 9000 standards (ISO, 2007).

Table 3–5 is a standardised description of the principles in ISO 9000:2000 and ISO 9004:2000. In addition, the table provides examples of the benefits derived from their use and of actions managers typically take in applying the principles to improve their organisations' performance (ISO, 2007).

PRINCIPLE	DESCRIPTION	APPLICATION
	Every company relies on its	Continuous research and development on
	customers in order to succeed,	meeting customer needs and expectations
	thus it should continuously seek to	Linking company objectives to customer needs
	understand its customers' current	and expectations
	and future needs, and strive to fulfil	Communicating customer needs and
Principle 1:	and exceed those identified	expectations throughout the organisation
Customer focus	customer expectations.	Measure and take improvement actions on
		customer satisfaction
		• Systematically managing customer relationships
		Adopt a balanced approach between satisfying
		customers and other stakeholders

Table 3-5: ISO quality principles

PRINCIPLE	DESCRIPTION	APPLICATION
	Leaders establish the harmony	Considering the needs and expectations of all
	and direction of the organisation.	organisational stakeholders
	They have to build and maintain	Institute a comprehensible vision of the
	the culture in which people can	organisation's future
	become fully involved in achieving	Setting challenging goals and targets
	the organisation's objectives.	• Build and sustain collective values, equality and
Principle 2:		ethical role models at all levels of the
Leadership		organisation
		Ascertain trust and eliminate fear
		Make available to people the necessary
		resources, training and freedom to act with
		responsibility and accountability
		• Stimulate, encourage and recognise people's
		contributions
	People at all levels are the	People's awareness of the importance and
	essence of an organisation and	significance of their contribution in the
	their complete involvement and	organisation as a larger context
	participation facilitates their	People identifying constraints to their
	capability to be used for the	performance.
	organisation's advantage.	People accepting ownership of problems and
		their responsibility for solving them
Principle 3:		People evaluating their performance against
people		their personal goals and objectives
		People actively seeking opportunities to
		enhance their competence, knowledge and
		experience
		People freely sharing knowledge and
		experience
		People openly discussing problems and issues
	A desired result is achieved more	Systematically defining the activities necessary
	efficiently when activities and	to obtain a desired result
Principle 4:	related resources are managed as	Establishing clear responsibility and
Process approach	a process.	accountability for managing key activities
		Analysing and measuring the capability of key
		activities

PRINCIPLE	DESCRIPTION	APPLICATION
		Identifying the interfaces of key activities within
		and between the functions of the organisation
		Focusing on the factors that will improve the key
		activities of the organisation, such as resources,
		methods and materials
		Evaluating risks, consequences and impact of
		activities on customers, suppliers and other
		interested parties
	It is essential for any organisation	Organising a system to accomplish the
	to recognise and manage	organisation's goals in the most effective and
	interconnected processes as a	efficient manner
	system that contributes to the	Considering the interdependencies between the
	organisation's effectiveness and	processes of the system
	efficiency in realising its goals	Adopting approaches that harmonise and
		integrate processes
Principle 5:		Facilitating a better understanding of the roles
System approach		and responsibilities necessary for achieving
to management		common goals and thereby reducing cross-
		functional barriers
		Understanding organisational capabilities and
		establishing resource constraints prior to action
		Targeting and defining how specific activities
		within a system should operate
		Continually improving the system through
		measurement and evaluation
	Continual improvement of the	Adopting a reliable approach to continual
	organisation's general	improvement of the organisation's performance
	performance should be an	Training and awareness on methods and tools
	undeviating purpose of an	for continual improvement
Principle 6:	organisation aiming to meet the	• Making the continual improvement of products,
improvement	changing needs of its customers.	processes and systems an objective for every
P		individual in the organisation
		Establishing goals to guide, and measures to
		track, continual improvement
		Recognising and acknowledging improvements

PRINCIPLE	DESCRIPTION	APPLICATION
	Effective decisions are based on	Ensuring that data and information are
	the analysis of data and	sufficiently accurate and reliable
	information.	Making data accessible to those who need it
Principle 7: Factual approach		Analysing data and information using valid
to decision-		methods
такіпд		Making decisions and taking action based on
		factual analysis, balanced with experience and
		intuition
	An organisation and its suppliers	Establishing relationships that balance short-
	are interdependent and a mutually	term gains with long-term considerations
	beneficial relationship enhances	Pooling of expertise and resources with partners
	the ability of both to create value.	 Identifying and selecting key suppliers
Principle 8: Mutually		Clear and open communication
beneficial supplier		Sharing information and future plans
relationships		Establishing joint development and
		improvement activities
		Inspiring, encouraging and recognising
		improvements and achievements by suppliers

Source: ISO (2007)

Implementing the ISO quality principles appropriately allows for the realisation of improved performance and quality within an organisation. Since the context of this research is the healthcare sector, it became important to review the standards relating to this context. The ISO has published the IWA 1:2005(E) standard for quality management systems, which provides guidelines for performance improvement based on ISO 9004:2000 (ISO, 2005), discussed below.

3.6.1.3 IWA 1:2005(E) Quality Management Systems: guidelines for process improvements in health service organisations

In order to counter rapidly changing and urgent market requirements, ISO has introduced the possibility of preparing documents through a workshop mechanism, external to its normal committee processes (IWA 1: 2005). These documents are published by ISO as International

Workshop Agreements (IWA) (IWA1:2005). The IWAs are approved by consensus among the individual participants in such workshops and are reviewed after three years (IWA1:2005). Although it is permissible for competing IWAs to exist on the same subject, an IWA shall not conflict with an existing ISO or IEC standard (IWA1:2005).

IWA 1 was approved at a workshop organised jointly by the Automotive Industry Action Group (AIAG), the American Society for Quality (ASQ) (Healthcare Division), the Standards Council of Canada (SCC) and CSA International, and held in January 2001 (IWA1:2005). Appreciation is extended to the Automotive Industry Action Group (AIAG), the American Society for Quality (ASQ) (Healthcare Division), the Standards Council of Canada (SCC) and CSA International for both the organisation of the workshop and the preparation of this IWA (IWA1:2005). The second edition (IWA 1:2005) cancels and replaces the first edition (IWA 1:2001) as it provides the content of the first edition with an improved appearance (IWA1:2005).

This standard provides ways to interpret the ISO 9000 series of standards for health service organisations (IWA1:2005), and provides additional guidance for any health service organisation involved in the management, delivery or administration of health service products or services, including training and/or research, in the life continuum process for human beings, regardless of type, size and the product or service provided (IWA1:2005).

The goal of this standard is to aid the development or improvement of a quality management system for health service organisations that provides for continuous improvement, emphasising error or adverse outcomes prevention, and the reduction of variation and organisational waste, for example non-value added activities (IWA1:2005). This guide incorporates much of the ISO 9004:2000 and provides guidance on quality management systems, including the processes for continual improvement that contribute to the satisfaction of a health service organisation's customers and other interested parties (IWA1:2005). The quality management system should provide for all customers of a health service organisation regardless of the product, profession or service provided (IWA1:2005).

The ISO promotes the adoption of a process approach when developing, implementing and improving the effectiveness and efficiency of a quality management system to enhance interested party satisfaction by meeting interested party requirements (ISO, 2007). This standard advocates for health service organisations to define all their processes. These processes, which are typically multidisciplinary, include administrative and other support services, and those involving treatment. They include the following examples (IWA 1: 2005):

- development and delivery of training as required by competencies or credentialing;
- surgery processes and the necessary ancillary support services;
- preventive and predictive maintenance programmes;
- design and/or development of diagnostic protocols/pathways;
- billing and coding for services correctly;
- continuum of care for patient, regardless of setting or location.

The next section reviews the role of quality models/frameworks in stimulating the attainment of improved quality levels worldwide.

3.7 QA MODELS

The following subsections focus on, address and define the different models that can be used to assure quality and improve the organisation processes' maturity levels.

3.7.1 European Foundation for Quality Management (EFQM) Model

The European Foundation for Quality Management (EFQM) Excellence Model was introduced at the beginning of 1992 as a framework for assessing applications for the European Quality Award. It is a widely used organisational framework in Europe and has become the basis for a series of national and regional quality awards (LRN, 2009). Additionally, the model provides organisations with a common management language and tool, thus facilitating the sharing of "good practice" across different sectors throughout Europe. While quality awards are the focus for some users, the true measure of the EFQM Excellence Model's effectiveness is its use as a management system and the associated growth in the key management discipline of organisational self-assessment. It is a practical tool to help organisations do this by measuring where they are with regard to becoming a quality organisation. The framework assists them in understanding gaps and simulating solutions, and is applicable to organisations irrespective of their size, structure or sector (LRN, 2009).

The EFQM was created to promote world-class approaches to the management of European organisations that would lead to sustainable excellence. The EFQM Excellence Model was introduced as the primary framework for assessing and improving organisations so that they might achieve such a sustainable advantage. This Model is based on the concepts of excellence. Excellence is not a theory but relates to the tangible achievements of an organisation in what it does, how it does it, the results it gets and the confidence that these results will be sustained in the future (EFQM, 2009).

The EFQM Excellence Model is a non-prescriptive framework that recognises that there are many different approaches to achieving sustainable excellence. The framework does, however, have some fundamental concepts, but they are flexible to allow for change over time as organisations develop and improve (LRN, 2009; EFQM, 2009). These fundamental concepts can be summarised as follows (LRN, 2009; EFQM, 2009):

- results orientation;
- customer focus;
- leadership and constancy of purpose;
- management by processes and facts;
- people development and involvement;
- continuous learning, innovation and improvement;
- partnership development;
- corporate social responsibility.

These concepts have been incorporated into the model's nine criteria. These criteria are grouped in two broad areas (EFQM, 2009):

- Enablers How does the organisation do things?
- Results What does the organisation target, measure and achieve?

The enabler criteria cover how an organisation does things and the results criteria cover what an organisation targets, measures and achieves. Results are caused by enablers and feedback from results help to improve enablers (LRN, 2009). Each of these nine criteria is an area of activity that contributes to the organisation's success. By regularly reviewing activities and results in these areas, organisations can test their progress towards continuous improvement. The organisation may opt to adopt some part of the model or all of it, depending on the their needs and objectives.



The linkages between the criteria are illustrated in Figure 3–5 below.

Figure 3-1: Linkage of the EFQM Excellence Model

Source: LRN (2009); EFQM (2009)

The use of this model is one significant way for an organisation to clarify its strategy; develop effective plans; deliver tangible improvements in all areas; and benchmark these against
others. The success of this model adoption lies with the commitment of the organisation's senior management and their involvement in the implementation process.

The next discussion will be on the Australian Business Excellence Framework (ABEF) used in Australia.

3.7.2 The Australian Business Excellence Framework (ABEF)

The Australian Business Excellence Framework (ABEF) is Australia's Framework for innovation, improvement and long-term success, and is applicable to all organisations in the country, large and small, private and public, whatever their purpose. The Framework has been designed to assist organisations to measure current performance and build a pathway to long-term success (ABEF, 2003).

The Framework was developed in 1987 and was one of the first four global excellence frameworks. It was initially developed in response to the Commonwealth Government and general industry calls for Australian enterprises to be more efficient and competitive. The Framework is reviewed and updated annually by a committee consisting of management and leadership experts to reflect the latest in management thinking and practice (ABEF, 2003).

The Australian Framework was developed with the objective of describing the principles and practices that create high performing organisations. The criteria can be used by organisations to assess their performance and drive continuous and sustainable improvement in their leadership and management systems (ABEF, 2003).

As stated by the ABEF (2003), this Framework is used as the assessment criteria for the Australian Business Excellence Framework. Through the Awards, organisations can be recognised for their achievements in excellence and improvement. The ABEF is a non-prescriptive leadership and management system that describes the essential elements of organisational systems in seven categories and it is based on twelve quality principles, as shown below:

3.7.2.1 The principles

These principles include the following (ABEF, 2003):

- 1. Clear direction allows for organisational alignment and a focus on the achievement of goals.
- 2. Mutually agreed plans translate organisational direction into actions.
- 3. Understanding what customer's value, now and in the future, influences organisational direction, strategy and action.
- 4. To improve the outcome, improve the system and its associated processes.
- 5. The potential of an organisation is realised through its people's enthusiasm, resourcefulness and participation.
- 6. Continual improvement and innovation depend on continual learning.
- 7. All people work in a system; outcomes are improved when people work on the system.
- 8. Effective use of facts, data and knowledge leads to improved decisions.
- 9. All systems and processes exhibit variability, which impacts on predictability and performance.
- 10. Organisations provide value to the community through their actions to ensure a clean, safe, fair and prosperous society.
- 11. Sustainability is determined by an organisation's ability to create and deliver value for all its stakeholders.
- 12. Senior leadership's constant role modelling of these principles and its creation of a supportive environment to live these principles are necessary for the organisation to reach its true potential.

3.7.2.2 The categories

These principles are further grouped in the following categories (ABEF, 2003):

- 1. Leadership and innovation.
- 2. Strategy and planning process.
- 3. Data information and knowledge.
- 4. People.

- 5. Customer and market focus.
- 6. Processes, products and services.
- 7. Business results.

Figure 3–2 below depicts these categories:



Figure 3-2: Seven ABEF performance categories Source: ABEF (2003)

Additionally, the ABEF provides a self-assessment matrix which can be used to assess an organisation's performance against the categories of the framework. The assessment dimensions are represented as (ABEF, 2003):

- approach .
- deployment.
- Results.
- improvement.

The items are evaluated by exploring how the organisation puts plans and structures into place; deploys those plans and structures; measures and analyses the outcomes; and learns from its experience. These are known as the "Assessment Dimensions" of Approach, Deployment, Results, and Improvement (ADRI).

In addition to good quality management activities, quality planning, QA and quality control, and quality improvement methods and models, there are several other important issues involved in improving the quality of IT projects, including strong leadership, understanding the cost of quality, providing a good workplace to enhance quality, and working towards improving the organisation's overall maturity levels in software development and project management. Hence, maturity models are discussed next.

3.8 MATURITY MODELS

Another approach to improve quality is the use of maturity models, which are defined as frameworks for helping organisations improve their processes and systems. They describe an evolutionary path of increasingly organised and systematically more mature processes (Schwalbe, 2007). A model includes a method for assessing projects' maturity levels as a first step to determining the improvements needed to increase the capacity of the project to deliver the project outputs as promised (PM4DEV, 2008).

According to Funchall (2009), maturity implies a potential for growth in capability and indicates both the sustainability of the process and the consistency with which it is applied throughout all divisions of the organisation. The term "maturity" is used in agreement with the CMMI (Capability Maturity Model Integrated, version 1.1, 2002: 624), which states that maturity is the degree of process improvement across a predetermined set of process areas in which goals within the set are attained. This view is supported by Curtis, Hefley and Miller (2002: 512), who maintain that the maturity level refers to a level of organisational capability created by the transformation of one or more domains of an organisation's processes. It is an evolutionary plateau on an organisation's improvement path from ad hoc practices to a state of continuous improvement.

In addition, Fraser, Moultrie and Gregory (2002) refer to process maturity as the degree to which processes and activities are executed following "good practice" principles and are defined, managed and repeatable. The fact that maturity has been defined as such indicates

its dynamic nature. As an aspect in the IT initiative domain, maturity is a function of the ability to keep pace with and manage change to meet organisational strategic demands. According to Schwalbe (2007), the following are the most popular maturity models, which are viewed in this study as having the possibility of being the most sensible model for e-health solutions acquisitions.

3.8.1 The Capability Maturity Model Integration (CMMI)

According to Duggan, Niwa and Hotle (2006), boosts in application development productivity and quality come most readily from the consistent execution of two approaches: a balance of effective management processes and repeatable low-level development processes. Organisations interested in enhancing the productivity and quality of system development activities should standardise development processes with some type of system development methodology. In concurrence, the Carnegie Mellon Software Engineering Institute (SEI) has taken the process management premise, "the quality of a system or product is highly influenced by the quality of the process used to develop and maintain it" (SEI, 2007).

In response to this, several maturity models, standards, methodologies and guidelines that can help an organisation improve the way it does business have emerged. However, most available improvement approaches focus on a specific part of the business and do not take a systemic approach to the problems that most organisations are facing. By focusing on improving one area of a business, these models have unfortunately perpetuated the stovepipes and barriers that exist in organisations. The Capability Maturity Model Integration (CMMI) provides an opportunity to avoid or eliminate these stovepipes and barriers through integrated models that transcend disciplines (SEI, 2007).

CMMI is a process improvement approach that provides organizations with the essential elements of effective processes. It can be used to guide process improvement across a project, a division, or an entire organization. CMMI helps integrate traditionally separate organizational functions, set process improvement goals and priorities, provide guidance for quality processes, and provide a point of reference for appraising current processes (SEI, 2007).

The SEI (2007) defines a process as not only being part of the process–people–technology triad, but as the glue that holds the triad together. Having the best skilled, energetic and highly motivated people and state-of-the-art technology does not guarantee effectiveness without appropriate processes. Process, people and technology are the major determinants of product costs, schedules and quality. A CMMI model is not a process but it does describe the characteristics of effective processes.

The SEI has developed a model and questionnaire to measure the maturity of the software development process. The SEI's Capability Maturity Model (CMM) provides guidelines against which an organisation is able to measure its own software process capability. The CMM is a software process framework for developing software through key practice areas (KPAs), which enable organisations to improve their ability to meet goals of cost, schedule and quality.

While the CMM was gaining exposure and acceptance in the United States, an alternative set of QA-orientated standards, namely ISO-9001, was being publicised by the ISO. As a result of the ISO influence, the SEI recently developed the Capability Maturity Model Integration (CMMI). The CMMI is a framework intended to integrate the many models currently in existence worldwide, including ISO-9001, but not limited to the disciplines of systems and software engineering. It comprises five maturity levels, whereas the CMM was organised into KPAs. The United States Air Force (USAF) Software Technology Support Centre (2002) developed a mapping of CMMI-SE/SQ Version 1.1 to SW-CMM in January 2002.

The capability levels enable an organisation to track, evaluate and demonstrate progress as it improves processes associated with a process area. The capability levels build on each other, providing a recommended order for approaching process improvement. There are six capability levels, designated by the numbers 0 through 5, as shown in the following table:

Table 3-6: CMMI's six capability levels

Capability level	Description
0	Incomplete
1	Performed
2	Managed
3	Defined
4	Quantitatively managed
5	Optimising

Source: SEI (2007)

Maturity levels belong to the staged representation and are applied to an organisation's overall maturity. There are five maturity levels, numbered 1 through 5. Each maturity level comprises a predefined set of process areas, as can be seen in the following table:

Table 3-7: CMMI five maturity levels

Maturity level	Staged representation
1	Initial
2	Managed
3	Defined
4	Quantitatively managed
5	Optimizing

Source: SEI (2007)

The organisational process assets that are described in the CMMI models (SEI, 2002) include the following:

- The organisation's set of standard processes, including the process architectures and process elements;
- Descriptions of life cycle models approved for use;
- Guidelines and criteria for tailoring the organisation have a set of standard processes;
- The organisation's measurement repository;
- The organisation's process asset library.

For an organisation to have attained a maturity level 2 indicates that the organisation has some basic and essential processes for undertaking software development projects and that it can be assured that the potential for delivering a quality product or service, within budget and schedule, is good.

It is, therefore ,important for this study to determine an organisation's maturity level before undertaking QA initiatives to ensure that the latter meet and support the level at which the organisation is currently operating. The Software Quality Function Deployment Model is summarised next.

3.8.2 Software Quality Function Deployment Model (SQFD)

This model focuses on defining user requirements and planning software projects. The result of this model is a set of measurable technical product specifications and their priorities. Schwalbe (2007) further states that having clear requirements can lead to fewer design changes, increased productivity and software products that are more likely to satisfy the stakeholder requirements. The project management maturity model is outlined.

3.8.3 Project Management Maturity Model

Organisations have realised that they need to improve their software development process and systems. They have realised the need to enhance the project management processes and systems for all types of project (Schwalbe, 2007: 342). As a result, the Organizational Project Management Maturity Model (OPM3) was introduced. According to Schlichter (2003), this model is aimed at helping organisations to assess and improve their project management capabilities, and the capabilities necessary to achieve organisational strategies through projects. The OPM3 sets standards for excellence in project, programme and portfolio management best practices, and in explaining the capabilities necessary to achieve the best practices (Schlichter, 2003). The following section focuses on QA methodologies as these relate to QA standards, because such methodologies provide frameworks and guidance for organisations in the implementation of quality standards.

3.9 QUALITY ASSURANCE METHODOLOGY

This section discusses a QA methodology that can be used to ensure quality during system implementation projects, namely, Six Sigma.

3.9.1 Six Sigma

Six Sigma approaches are a collection of managerial, statistical concepts and techniques that focus on reducing variation in processes and preventing deficiencies in products (Gryna *et al.*, 2007: 67).

Oande, Neuman and Cavanagh (2000) define Six-Sigma as "a comprehensive and flexible system for achieving, sustaining and maximizing business success. Six Sigma is uniquely driven by close understanding of customer needs, disciplined use of facts, data, and statistical analysis, and diligent attention to managing, improving, and reinventing business processes".

Morgan and Brenig-Jones (2001) state that Six Sigma is becoming so popular because every aspect of an organisation's processes, products or services is prone to defects or problems that the customer has identified as important. Six Sigma is a rigorous quantitative approach to quality improvement and Six Sigma performance equals to 3.4 defects per million opportunities. Morgan and Brenig-Jones (2001) quote Albert Einstein in saying: "The significant problems we face cannot be solved by the same level of thinking which caused them."

Morgan and Brenig-Jones (2001) continue to say that Six Sigma scores better than many other quality approaches. It involves a rigorous approach to understanding customer requirements and translating them into specific and measurable outputs. It aligns this voice of the customer with the voice of the process, improving the design and operation of key processes to consistently meet customer needs. There is strong emphasis on management by fact and data, and not merely relying on people's opinions and experience, which can be fallible. Furthermore, Six Sigma is focused on issues and problems important to both the business and the customer, and is delivered through manageable-sized projects prioritised in line with the business's strategy.

Six Sigma has two key methodologies, namely the Define, Measure, Analyse, Improve, Control (DMAIC) methodology and the Define, Measure, Analyse, Design, Verify (DMADV) methodology. DMAIC is used to improve an existing business process, whereas DMADV (lately referred to as Design For Six Sigma – DFSS) is used to create new product or process designs in such a way that it results in a more predictable, mature and defect-free performance (Chua, 2001; Harry & Schroeder, 2000; Hahn, Doganaksoy & Hoerl, 2000; Chua & Jansen, 2000; Hanson, 2006). Sometimes a DMAIC project may turn into a DFSS project because the process in question requires a complete redesign to bring about the desired degree of improvement. The following are short descriptions of each of these methodologies, which provide a more detailed understanding of the DFSS methodology.

3.9.1.1 DMAIC

The DMAIC process is aimed mainly at reducing defects and errors in existing products, services and processes (Gryna *et al.*, 2007: 145).

The basic methodology of DMAIC (Schwalbe, 2007; Gryna *et al.*, 2007: 145; Hahn *et al.*, 2000) consists of the following five steps:

- Define (**D**) the process improvement goals that are consistent with customer demands and enterprise strategy.
- Measure (*M*) the current process and collect relevant data for future comparison.
- Analyse (*A*) to verify he relationship and causality of factors. Determine what the relationship is and attempt to ensure that all factors have been considered.

- Improve (*I*) or optimise the process based on the analysis using techniques like the design of experiments.
- Control (*C*) to ensure that any variances are corrected before they result in defects. Set up pilot runs to establish process capability and transition to production; thereafter continuously measure the process and institute control mechanisms.

It is evident that DMAIC is used to improve an existing business process. However, the importance of design has led to the adoption of Six Sigma in design projects, thus a new addition, that is, the six sigma quality methodology for design (DFSS), has emerged, which is discussed below.

3.9.1.2 DFSS

The DFSS methodology is a separate and emerging discipline related to Six Sigma's quality processes. The tools and order used in Six Sigma require a process to be in place and be functioning. DFSS has a different objective, that is, to determine the needs of the customers and the business, and to drive those needs into the product solution created. DFSS is relevant to the complex system/product synthesis phase, especially in the context of unprecedented system development. Contrasted with this is the traditional DMAIC Six Sigma process as it is usually practised, that is, with a focus on the evolutionary and continuous improvement of manufacturing or service process development. DMAIC Six Sigma usually occurs after the initial system or product design and development have largely been completed. In this way, DMAIC Six Sigma is usually consumed with solving existing manufacturing or service process problems (Chua, 2001; Hanson, 2006).

DFSS seeks to avoid manufacturing or service process problems by using systems engineering techniques to avoid process problems at the outset. These techniques include tools and processes to predict, model and simulate the product delivery system (the processes/tools, personnel and organisation, training, facilities and logistics to produce the product or service), and the analysis to develop the system life cycle itself to ensure customer satisfaction with the proposed system design solution. DFSS is largely a design activity requiring specialised tools. These include, but are not limited to, quality function deployment. While these tools are sometimes used in the classic DMAIC Six Sigma process, they are uniquely used by DFSS to analyse new and unprecedented systems or products.

DFSS consist of the five steps denoted in DMAV, as shown below (Hahn et al., 2000):

- **Define (D)** identify the new (or modified) product to be designed and define a project team and plan.
- *Measure (M)* plan and conduct research to understand customer needs and related requirements.
- **Analyse (A)** develop alternative design concepts, select a concept for high-level design, and predict the capability of the design to meet requirements.
- **Design (D)** develop the detailed design, evaluate its capability and plan a pilot test.
- Verify (V) conduct the pilot test, analyse the results and make design changes if needed.

It is evident that DFSS is focused on creating new or modified designs that are capable of significantly higher levels of performance, while the DMADV sequence is a design methodology applicable to developing new or revised products, services, and processes (Gryna *et al.*, 2007: 148). With all the capabilities offered by Six Sigma, several organisations have adopted this methodology in developing their products or services for improved quality, even in software development projects.

This chapter highlights that quality is defined in various terms, but at its core it relates to meeting customers' needs and expectations. It is evident that a definition of quality for any organisation's products or services is based on their customers' view of what quality means. In order for organisations to combat issues of lack of quality, the adoption of TQM provides a vehicle by means of which organisations can continuously improve their processes towards quality products and services. However, it is important for organisations to introduce quality at the product or service design phase by adopting QA processes in project management.

This discussion indicates that QA is a proactive programme of planned, systematic activities that analyse, monitor and evaluate whether the necessary processes are in place and are continuously improved to provide adequate confidence that standards of quality are being met and that the product or service ultimately fulfils customers' requirements and expectations. These planned systematic activities include policies, procedures, training, measurements and analysis.

The emphasis on ensuring quality should be more on the process rather than the products, as it is assumed that improved processes will ultimately improve the quality of the products. An efficient QA system will define, prioritise, quantify and measure the processes and techniques throughout the product's lifecycle to enable early detection and corrective actions of deficiencies that could significantly reduce the impact on cost and time (Von Solms, 2006). If implemented correctly, QA will provide a means by which defects are proactively identified, anticipated and mitigated during development and production. It will provide a means by which defects are identified as they arise. QA will also take into account human and technological factors (Von Solms, 2006).

Although there are ISO standards, QA models and methods and quality management approaches that address the various aspects that could enhance quality in any organisation, it is important to address the client's expectations. Thus, the standards, models and methods discussed in this chapter provide the essentials for each organisation to customise and develop their locally relevant methods. Therefore, in this study they are used as a theoretical framework to develop the GQAM for e-health acquisition project management processes to ensure quality in the solutions that are implemented in rural hospitals in the Eastern Cape Province. The QA activities should, therefore, be driven by the client's needs and expectations. If these are ignored, misinterpreted or incorrectly identified, the final product will not deliver the required quality. However, not all expectations can be met.

Although quality is difficult to define, it must be judged within a context. Batalden and Davidoff (2006) state that many people in healthcare today are interested in defining quality improvement. These authors propose defining it as the combined and unceasing efforts of

everyone - healthcare professionals, patients and their families, researchers, payers, planners and educators – to make the changes that will lead to better patient outcomes (health), better system performance (care) and better professional development. In this context it becomes important to ensure that the quality of e-health solutions is based on its core values or components, which is to enhance service delivery, support decision making, reduce costs and further enable services for rural communities. This study aims to investigate ways in which QA can be adopted in e-health acquisition to satisfy the needs of its users and add value to healthcare service delivery in rural areas.

3.10 CONCLUSION

In response to the urban–rural digital divide in the healthcare sector in South Africa, various e-health related initiatives have been launched to counteract the disparities that characterise such a divide. With the rapid developments in technology and the ever-changing understanding of the scope and potential of e-health solutions in healthcare centres in rural communities, it is evident that no solution can be implemented as is, especially not those that originate in the developed world. As has been stated, quality should be viewed from the customers' perspective to meet their service expectations; hence, it is envisaged that this research project will serve as a starting point for a QA body of knowledge for e-health acquisition for rural hospitals, which can be further refined and enlarged with input from the growing number of e-health projects in South Africa.

In this chapter it was noted that quality experts offer different shorthand definitions of quality – "fitness for use" (Juran), "conformance to requirements" (Crosby), "loss of society" (Taguchi), and "predictable degree of uniformity" (Deming). These definitions are complementary and provide operational meaning at different phases of quality activities. Furthermore, other authors have elaborated on quality as "customer satisfaction and loyalty" (Gryna *et al.*, 2007). However, what is important is for the organisation to understand its customers' definition of quality and to ensure never-ending QA improvements through the adoption of TQM approaches using applicable or blended methodologies and frameworks for quality improvements.

For healthcare services, quality becomes a critical element; it is important to ensure quality in all solutions that are developed for healthcare services, as some of these solutions form part of the mission-critical systems. QA is t an important to help identify quality issues that may emerge in the initial stages of the project and can assist organisations to avoid the costs associated with a lack of quality.

4.1 INTRODUCTION

The previous two chapters, chapters 2 and 3, provide a review of the literature applicable to this study. In this chapter, the research design and methodology that are employed to answer the research questions are discussed. In the sections that follow, various aspects of the research methodology are discussed, including the research design, the research approach, data collection techniques, sampling and analysis, the collection and interpretation of the data, and the study participants. Before concluding the chapter, the issue of ethical considerations is addressed.

As depicted in the research study design in Figure 4–1, this research study started with an investigation into what the nature of the management dilemma was with regard to e-health acquisition. After in-depth investigations and analysis, the research questions that motivate this study were defined. These research questions serve as a directive for the two literature study chapters, which focus on ICT for development (Part 1) as a vehicle for bridging the digital divide and enhancing the quality of lives and healthcare in rural communities; and Quality: notions, standards, models and methodologies (Part 2) as different ways for installing quality and further assuring quality for the organisation's customers of products and services and meeting customer expectations. After the literature study, the appropriate research methodologies were selected and employed to collect, analyse and interpret the collected data to provide answers to the research questions. These findings have further informed the development of the Generic Quality Assurance Model (GQAM), which is recommended at the end of this study.

The research design overview that is used during this research study is illustrated in Figure 4-1, and is discussed in detail later on in section 4.2.



Figure 4-1: Detailed study design Source: Cooper & Schindler (2006: 55)

4.2 RESEARCH METHODOLOGY AND DESIGN

The phases followed in this project were depicted in the previous section. In this section, the research philosophy, approach, strategies and data collection methods adopted in this study are discussed.

According to Leedy and Ormrod (2001:3), research is a systematic method of gathering and analysing information or data to enhance the understanding of the facts that are of concern or interest. Research encompasses the application of a systematic and objective investigation to find answers to an identified problem.

Welman and Kruger (2005: 2) further define research as a process involving the application of various methods and techniques to create scientifically obtained knowledge by using objective methods and procedures.

A methodology is defined as an organised way, comprising sequences, procedures and systems, to manage and execute a research process (Welman & Kruger, 2005: 128; Olivier, 2004: 11) as illustrated in this research design in Figures 4-1 and 4-3. These authors state that the method should form a pattern for soliciting applicable data, processing, analysis and interpretation of data, drawing up conclusions, reporting the findings and making recommendations (Olivier, 2004: 28–37; Welman & Kruger, 2005: 128).

To elaborate on the research design overview provided in Figure 4-1, using the *research onion* as adopted from Saunders, Lewis and Thornhill (2000: 85), Figure 4-2 represents the research design used in the current study, which is discussed in this section. This model, as proposed by Saunders *et al.* (2000: 85), depicts the research design as an onion, composed of a number of layers which include the research philosophy, research approach, research strategy, time line and data collection methods. According to this model, the collection of data is central, although all the other layers of the onion have to be considered as decisions taken in one layer will influence the direction of the research, and the options and decisions in other layers.



Figure 4-2: The research process onion

Source: Saunders et al. (2000: 85)

The layers of this model, starting with the outermost layer which considers aspects of the research philosophy, are discussed in the next section.

4.2.1 Philosophy

A *phenomenological* research philosophy was applied during this study. As Leedy and Ormrod (2001 139) state, phenomenological studies attempt to understand people's perceptions, perspectives and particular events external to the person. This study attempts to draw such understandings and perceptions or perspectives about the QA methodologies employed in e-health solution acquisitions for rural healthcare centres to develop a GQAM that will aid the successful implementation of such systems.

For this study, a **social constructivist** research paradigm was applied, as the researcher's intent was to interpret the meanings the participants had attributed to their world in terms of QA and its applicability to their environment. As Creswell (2007: 21) states, researchers adopting this paradigm, interpret their findings and that interpretation is shaped by their own experiences and background. According to Creswell (2007: 20), researchers who adopt a social constructivist paradigm aim to understand the world in which they live and work, by developing subjective meanings of their experiences, which are varied and multiple, leading the researcher to look for the complexity of views rather than narrow down the meanings into a few categories or ideas. The main goal of the research is mostly the research participants' view of the situation under study (Creswell, 2007: 20).

As a result, the main research approach for this study was a qualitative approach, using multiple case studies.

4.2.2 Approach

This study mainly followed a **qualitative** research approach. Qualitative research has become increasingly popular owing to its participative nature and because it includes the stakeholders and participants and the researcher in all its phases or cycles (Carr & Kemmis, 1986: 67).

Qualitative research is an approach to the study of social interactions in their natural settings. It involves the collection and analysis of empirical information from multiple sources, such as first-person accounts, life histories, visual records, semi-structured and open-ended interviews, informal and formal observations, and biographical and autobiographical materials (Eckert, 1998). According to Henning *et al.* (2004: 3–11), qualitative studies usually aim for depth rather than "quality of understanding".

The overall purpose of adopting a qualitative research approach for this study was to gather non-numerical data to help explain and develop a GQAM for e-health acquisition. Accordingly, the methods used to obtain qualitative information included questionnaires, observation, interviews and document analysis. The information derived from these instruments was

combined into a GQAM that depicts the activities that should be included to ensure quality in e-health acquisition ,to be successful in implementing such solutions in rural hospitals. The research methodology was designed to help the researcher understand people and the social and cultural contexts within which they live and operate, which allowed the researcher to elicit the most valid and reliable data for the research. Holloway and Wheeler (2002:3) argue that qualitative research is a form of social inquiry that focuses on the way people interpret and make sense of their experiences and the world in which they live.

It was evident from the literature reviewed in chapters 2 and 3 that a theory base would not be efficient in guiding the study, as very little has been written about QA, especially in terms of systems acquisition in developing countries. Hence, the researcher had to involve the participants to elicit their understanding of quality and QA measures that are adopted in the e-health solution implementation, and the shortcomings they face when attempting to develop a model that will aid successful e-health acquisition in rural hospitals.

The next section discusses the strategies employed as part of the qualitative research to achieve the goals of this study.

4.2.3 Strategy

According to Babbie (2005: 295), field research observes the phenomenon under study in its natural environment, as completely as possible, in a participatory fashion and over a period of time, to develop a full understanding of the phenomenon. This study adopted case study as a strategy that would assist in achieving the goals of this project. In this study, the data were collected from multiple research fields to make sense of the participant's view on the factors relating to QA. The researcher used the data that were collected using the case study methods, and the draft method was developed and adapted at the different iterations using various data collection methods and expert reviews, until the final model was produced.

The case study as a research strategy is discussed in the subsections that follow.

4.2.3.1 Case studies

Creswell (2007) defines a case study as the study of an issue explored though one or more cases within a bounded system. According to Merriam (2001: 19–33), a case study is an indepth qualitative study of a single unit with specific boundaries, resulting in a comprehensive, intensive and holistic description of that system. The understanding gained from the description and analysis of a case study can lead to changes in practice.

Case study is an empirical inquiry that is used to investigate an existing phenomenon in its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (Myers & Burnett, 2004). Oates (2006: 141) maintains that a case study focuses on one instance of the 'thing' that is to be investigated: an organisation, a department, an information system, a discussion forum, a system developer, a development project, and so on.

It was found that case study is the most common qualitative method used in information systems research (Alavi & Carlson, 1992). Although there are several definitions, as mentioned above, Yin (2008) defines the scope of a case study as follows: "A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident."

Yin (2008) further advocates that: "As a research strategy, the case study is used in many situations to contribute to our knowledge of individual, group, organisational, social, political, and related phenomena."

Within case study research, the investigator has limited control and often focuses on the life cycle. The data obtained from a case study can be used to illustrate theories, evaluate theories based on the identified differences, and demonstrate the superiority, for implementers, of the interaction theory (Markus, 1983). Known case study researchers, such as Soy (1997), advocate six steps for case study research, as reflected in table 4-1 below:

Table	4-1: Six	steps i	in case	studv	research
		. otopo .			

Steps	Descriptor	Guidelines for the researcher
1	Determine and	Establish a firm research focus of a complex phenomenon or object by
	define the research	formulating questions about the situation being studied and determining the
	questions.	purpose of the study.
		Case study research generally answers questions beginning with "how" or "why".
2	Select the cases	Key element is selection of single or multiple cases; when using multiple cases,
	and determine data	each case is treated as a single case.
	gathering and data	Determine what evidence to gather from multiple sources and what analysis
	analysis	techniques to use.
	techniques.	Make sure that the study is well constructed to ensure construct validity, internal
		validity, external validity and reliability.
		Ensure that procedures used are well documented and that they can be
		repeated over and over with the same results.
3	Prepare to collect	Advance preparation is required to organise the data systematically, as large
	the data.	numbers of data are generated from multiple sources.
		Consider conducting a pilot study to remove obvious problems and barriers prior
		to initiating the fieldwork. Identify key people, prepare letters of introduction and
		establish rules for confidentiality.
4	Collect data in the	Collect and store multiple sources of evidence comprehensively and
	field.	systematically in formats that can be referenced and sorted so that converging
		lines of inquiry and patterns can be uncovered.
		It is mandatory to maintain the relationship between the issue and the evidence.
		Clearly document any renegotiation of arrangements with the objects of the
		study or addition of questions to interviews as the study progresses.
5	Evaluate and	Examine the raw data in order to find linkages between the research object and
	analyse the data.	outcomes with reference to the original research questions.
		Remain open to new opportunities and insights.
		Sort data in many different ways or triangulate data in order to strengthen
		research findings and conclusions.
		Treat the evidence fairly to produce analytic conclusions answering the original
		"how" and "why" research questions.
6	Prepare the report.	Report data in a way that transforms a complex issue into one that can be
		understood, allowing the reader to reach an understanding independent of the
		researcher. Use representative audience groups to review and comment on the
		draft document.

Source: Soy (1997)

The first step in conducting a case study is to determine and define the research questions about the situation being studied and to determine the purpose of the study. The second step is to select the cases and to establish whether a single or multiple case study design will be used, and to determine the data-gathering and data-analysis techniques. Thirdly, the systematic organisation of a large amount of data must be planned in advance and consideration must be given to conducting a pilot study to remove obvious problems and barriers prior to initiating the fieldwork. The fourth step entails collecting data in the field and maintaining the relationship between the issue and the evidence. The fifth step comprises the evaluation and analysis of the data and the final step entails preparing the report in such a way that a complex issue is transformed into one that can be understood, allowing the reader to reach an understanding independent of the researcher.

In concurrence with the second step as listed in table 4-1 above, Yin (1994: 1) states that a case study design can be either single or multiple:

- **Single cases** are used to corroborate or challenge a theory, or they can be used to represent a unique case. Single-case studies can be holistic or embedded.
- **Multiple-case** studies involve several unit of analysis. This allows for the collection of large amounts of information from diverse sources. They are used to provide an understanding using a number of instrumental case studies that either occur on the same site or come from multiple sites.

In concurrence with the above definitions, Gillham (2002: 1) refers to a case study as a study that investigates an individual, group, institution, organisation, or community to learn more about the particular situation. Therefore, for the purpose of this research, multiple-case study design has been applied for five rural community hospitals in the Eastern Cape Province.

According to Creswell (2007: 12), multiple-case study research is a qualitative research design in terms of which the researcher investigates a chain of single entities or phenomena or the case confined by time and activity, and collects detailed information by using a variety of data-collection procedures during a sustained period of time.

4.2.4 Time horizons

The time horizon for the study was **longitudinal** as this study was carried out; this means the data for this study were not collected on a single event, but within several interventions (Saunders *et al.*, 2000: 96).

4.2.5 Data-collection methods

In order to accomplish the objectives of this research, a study of the published literature was conducted to investigate and establish a theoretical framework for the study with the aim to establish the factors relating to the adoption of ICTs for development in rural areas in South Africa, with a focus on e-health solutions. Secondly, an investigation was conducted to establish guidelines for QA in solutions acquisition and, finally, to establish the key quality principles that are critical for the success of any project. The literature study was combined with case study research which included semi-structured interviews, closed questionnaires, observation, document analysis, and expert reviews as data collection instruments.

As shown in Figures 4-1 and 4-2, which depict the research design, this study has used both primary and secondary sources of data. According to Hofstee (2008), primary data refers to unpublished data that is collected directly from research participants and organisations; whilst secondary data refer to any materials that have been previously published, for example books, journals and research papers from conferences (Hofstee, 2008). In relation to this study, the purpose of each type of data is described below:

- Secondary data using a literature survey (Phase 1): The purpose of the literature survey was, firstly, to establish the factors relating to the adoption of ICTs for development in rural areas of South Africa, with a focus on e-health solutions. Secondly, an investigation was conducted to establish guidelines for QA in the acquisition of solutions. Lastly, it was intended to establish the key quality principles that are critical for any project success.
- Primary data using interviews, questionnaires, observation, document analysis (Phase 2) and expert reviews (Phase 3): The main objective in using these instruments was

to elicit the personal perceptions and organisational facts about QA, as a subset of project quality management in the acquisition of e-health solutions for rural hospital in the Eastern Cape Province of South Africa.

As shown in Figure 4-1, the collection of primary and secondary data was planned and conducted in phases. Figure 4-3 depicts these phases with their respective steps which were adopted in this study; with the findings of one phase being used as input for the next.



Figure 4-3: Research methodology summary

The steps of each of the phases are described in more detail in the following paragraphs.

4.2.5.1 Phase 1: Literature review and sampling of participants

Step 1:

Step 1 in Figure 4-3 illustrates the literature study on ICT for development (*cf* chapter 2) as a vehicle for bridging the digital divide by introducing innovative solutions that aim to develop and improve the quality of lives and enhance service delivery, including healthcare, for rural communities.

The second part of the literature study (also part of step 1 in Figure 4-2) concentrated on QA as a subset of project quality management in system acquisition and gaining insight into the

background to quality notions, standards, models and methods(*cf* chapter 3) as key concepts for success in systems acquisition.

Step 2:

After conducting the literature review (step 1 of phase 1), the next step (step 2) was to obtain authorisation for the study from the Eastern Cape Department of Health (*cf* Appendix C) and to further identify and select the study participants (*cf* section 4.3 for sampling discussion).

<u>Step 3:</u>

After the sample had been selected and the approval obtained, the intended study participants were contacted and asked to give their consent to participate on this study (*cf* section 4.4 for ethical considerations).

4.2.5.2 Phase 2: data collection and interpretation

Phase 2 consisted of three sub-phases, which will be discussed in more detail in the following subsections.

4.2.5.2.1 Sub-phase 2.1: Questionnaires

A questionnaire is a method of eliciting, recording and collecting information. Questionnaires are made up of items, and the users supply answers, or reactions to them (UCC, 2002: 1). Questionnaires require less time for participants to complete than most interviews or observational sessions. The anonymity usually afforded to questionnaires allows honest replies, without the fear of peer reprisal or attempts to please the interviewer. A variety of information can be quickly gained, namely factual, attitudinal, interpretational or opinions. Closed questions facilitate questionnaire analysis, while open-ended questions allow for

unanticipated responses. Negative aspects of using questionnaires relate to the complexity, time and resource commitment in construction and analysis, and reluctance by some participants to write at length (Bell, 1993).

The goal of this survey was to elicit quantitative data on the existence and use of QA methods in the project processes for acquiring e-health solutions for the selected rural hospitals. The survey aimed to elicit both the strengths and the role played by the existing methods on the projects success and the shortcomings of the existing QA methods. The data obtained were used to answer the research questions and as a basis for creating a quality model for e-heath solutions in rural hospitals.

The questionnaire was designed to capture data that could be analysed for correlations between the factors associated with the existence of QA methods and principles as expressed by participants, their value within the e-health acquisition projects, the ways in which they are implemented and their shortcomings, in relation to the QA methodologies, standards, models and principles (chapter 3). Where correlations are found, the specific factor is considered and included in the model to promote the success of the projects.

The questionnaire (*cf.* Appendix A) consisted of 11 main topics, which were designed to obtain information on the way in which QA is applied during the acquisition of the selected e-health solutions at the five rural hospitals in the Eastern Cape Province that had agreed to participate in the study. These topics were grouped into four sections (Section A–D) based on their relevance and relationship. These topics can be summarised as follows:

Section	Topic no.	Topic name	Objectives
Section A	0	General biographical Information	Understand the roles of the participants and their demographic information to elicit their view points.

Table 4-2: Summary of questionnaire sections and topics

	1	General Quality	Gather the general QA background of the organisation		
Section B		Management			
		System			
	2	Customer	Elicit the levels of customer involvement during the projects		
		involvement/partici			
		pation			
	3	Quality upfront	Determine whether QA activities are planned for upfront in the		
			project.		
	4	Project	Establishing whether strong project management disciplines		
		management	are applied.		
Section C		discipline			
Section C	5	Traceability	Determining the degree of traceability during the project.		
	6	Continuous	Ascertaining whether QA activities are continuously improved.		
		Improvement			
	7	Independent QA	Determining whether independent QA reviews are conducted.		
	8	Qualified staff	Establishing whether qualified staff was used to perform the		
			project's QA activities.		
	9	Clear accountability	Determine whether clear accountability was assigned during		
			the project.		
Section D	10	QA tools &	Determining whether any QA tools and techniques were		
		techniques	utilised during the project.		
	11	QA value-added	Determining if the QA activities performed added value and		
			assisted the success of the projects.		

Participants were provided with a list of questions pertaining to the various sections. In Section A, participants were asked to fill in the required information in the given spaces. A 3-point Likert scale (Yes, No, Don't Know) was used for *Section B*, and a 5-point Likert scale (1 – strongly agree to 5 – strongly disagree) was used for the other sections, to indicate the opinions of the participants. If the specific question was not relevant or not known to their participant or their organisation, this was indicated by entering point 3 on either sections (Don't Know – section A, Neither agree Nor disagree – on section B–D). The data collected from the questionnaires were captured witin a spreadsheet to summarise participants' responses and graphical representations were developed. These are presented in the respective sub-questions discussed in this and the next chapter. Purposive sampling was applied to select the participants who would be knowledgeable in terms of providing the information required by the questionnaire. Respondents included project managers, project coordinators, IT directors, senior management, and vendor representatives and managers. The questionnaire was emailed to the participants, who emailed them back on completion.

Although five hospitals, together with their respective five e-health solutions, were studied, it was found that throughout the solutions, the same people were involved when representing the department and the vendors, resulting in the following questionnaire participants totals.

Table 4-3: Questionnaire	participants
--------------------------	--------------

QUESTIONNAIRE PARTICIPANTS			
Category	Total N		
Vendors	3		
ECDoH*	6		
Total	9		

*Eastern Cape Department of Health (ECDoH)

A closed questionnaire (*cf* Appendix A) was used to elicit data from the purposively sampled participants. In order to verify that the data provided in the questionnaires are reliable and valid, and to further clarify the concerns of the data collected from the questionnaires, follow-up interviews were conducted. These are discussed next.

4.2.5.2.2 Sub-phase 2.2: Interviews (semi-structured interviews)

The questionnaire was supported by the development of semi-structured interview questions which were posed to the study participants. These semi-structured interview questions aimed to validate and to close the analysis gaps of the data collected by means of the questionnaire by allowing all the project team members involved in the acquisition e-health solutions in rural hospitals to participate in the study. The interview questions were structured around the

quality principles, as shown in the questionnaire above, but were simplified to enable even the non-technical participants to answer. The objectives of the interview were to:

- validate the data gathered from the questionnaires relating to the QA methodologies that were used in project when implementing the existing e-health solutions, and to further determine how those adopted QA methodologies were used as compared to available QA methodologies and standards.
- determine the participants' perceptions and experiences of the value added by these adopted methodologies in supporting the successful acquisition of e-health solutions in rural hospitals.
- discover the challenges relating to QA that were experienced when adopting these methodologies during the e-health acquisition project.
- elicit respondents' perceptions of quality and the requirements for QA models in e-health acquisition projects.

From the literature study, it was evident that issues relating to project quality management were the factors that contributed to ICT projects failure, especially in developing countries (chapters 2 and 3). Although there is a strong base of knowledge available in the literature on quality management, standards, methodologies, models and principles, a study of it concluded that these quality principles and standards cannot be adopted as is, but that organisations have to develop their own methodologies to comply with these principles and standards to ensure the quality of the processes and systems they implement.

Although there several studies on e-health solutions examined in the literature, there is limited scope on their implementation in rural areas in developing countries, especially in South Africa. Of those that do focus on the South African context, none dealt with the scope of this research and only individual questions and issues can be reused.

According to Gay and Airasian (2003: 224), an interview is a purposive interaction between two or more persons, with the one (the researcher) trying to obtain information from the other (participants). Interviews permit a researcher to obtain information that cannot be obtained from observations. Qualitative interviews are free flowing and open ended, with the interviewer probing to clarify and extend the participants' comments.

Semi-structured interviews were adopted in this study as they provide the researcher with opportunities to introduce new material into the discussion that was not previously thought of, but which developed during the course of the interview (Hitchcock & Hughes, 1989: 79). With semi-structured interviews, the interviewer has a clear list of issues to address and questions to be answered, and is prepared to be flexible in terms of the order in which the topics are considered. In interviews, answers are open ended (Denscombe, 2003: 167).

Interviewees were selected from the point of view of representation, but their relevance to the questions was taken into consideration. All the e-health solution project team members were interviewed, including the information technology specialist, management, project management, QA, business analysis, and the vendor and user representative. As Gay and Airasian (2003: 224) strongly recommend that the interviews should be recorded and transcribe, as these transcripts constitute the interviewer's field notes and become the data that the researcher will analyse. Accordingly, all interviews were captured by on a tape recorder and later in the form of an MsWord document. Some notes were taken during the stakeholder interview sessions. The analysis of the interview notes made it possible to understand the interviewees' opinions and their knowledge about the phenomena investigated; and this information was used to answer research questions and to further facilitate the development of a draft QA model for e-health acquisition for rural hospitals.

Purposive sampling was used to interview only those who were part of the implemented ehealth solution project team; to gain more information on other issues relating to quality in use and the current users of the solutions were also interviewed. In addition, expert reviews in the field of solution design and quality were used. The information obtained assisted in obtaining background on the QA activities used during system implementation and use. Table 4-4 summarises the interview participants in this study. Owing to ethical consideration, information on the participants' demographics is restricted so that answers cannot be linked to specific participants:

INTERVIEW PARTICIPANTS			
Category	Total N		
Vendors	3		
ECDoH	6		
Site coordinators	5		
Users (doctors, nurses, radiographers, etc)	15		
Expert reviews	6		
Total	35		

Table 4-4: Interview participants

Therefore, total study participants were 35, composed of a total of 29 participants selected from 5 different hospitals, to form 5 case studies as well as 6 independent experts selected for expert reviews.

4.2.5.2.3 Sub-phase 2.3: Document analysis

The analysis of documents, such as the minutes of meetings, letters, policy documents, reports, customer feedback forms and newsletters, allows for comparison with the other data collected. Documents can provide written evidence to support or contradict claims made in interviews or questionnaires.

For this study, the accessible reports, email communication, manuals, policies, business cases and minutes of meetings were used to validate the answers to the research questions obtained from the questionnaires and interviews, and to close the analysis gaps. Document analysis was used mainly to elicit the QA methods used currently and to identify the value they add and their shortcomings in relation to project quality management.

4.2.5.2.4 Sub-phase 2.4: Observation

Observation is a technique that involves systematically selecting, watching and recording behaviour and characteristics of living beings, object or facts (Denscombe, 2003: 30–31). The observation technique qualifies as a scientific inquiry when conducted specifically to answer research questions that are systematically planned and executed, uses proper controls, and provides a reliable and valid account of what happened (Cooper & Schindler, 2003: 400).

During the site visits, the researcher observed some elements. Although some of the elements were a result of culture and the processes used, others were specifically related to issues of QA, especially those that relate to quality-in-use for the implemented e-health solutions, which refers to the quality after the implementation of solutions had been observed and presented in this chapter. The relevant observation outcomes were noted as additions to support the findings obtained from the questionnaires and interviews. For the purpose of this study, anecdotal records were used to collect and keep notes of the observations.

<u>Step 4:</u>

Collect the data from the selected participants using the data collection instruments and the processes discussed above.

<u>Step 5:</u>

The collected data were interpreted and analysed (*cf* section 4.4 for data analysis discussions) to answer the research questions and to elicit the components required for model development.

4.2.5.3 Phase 3: draft model development

The findings obtained from the previous phases (phase 1 & 2) informed the development of a GQAM in its draft form (step 6) in phase 3. This model was developed for possible adoption

by organisations in e-health acquisition projects for rural hospitals in the Eastern Cape Province to ensure that quality solutions are successfully implemented to add value and improve service delivery and the healthcare of users (rural healthcare professionals and communities served).

In order to develop a GQAM in a manner that is relevant and fits the context of its implementation, the user involvement approach was adopted, which involved the e-health team and other relevant stakeholders. To further ensure that the model was in general practice and could fit into any typical solution development life cycle (SDLC), experts' reviews were considered. Expert reviews and the model development cycles formed the sub-phases of this phase, and are discussed.

Step 6:

In this phase, the findings obtained from the case studies were used to develop the first draft of the QA model in layers.

<u>Step 7:</u>

The layers continued through to Phase 4 where the draft QA model developed from the case study findings evolved until the final generic QA model (GQAM) was produced. This was achieved through a series of reviews, within different series of model development cycles.

4.2.5.3.1 Sub-phase 3.1: Expert reviews/opinions

As Van Greunen (2009) states, when dealing with opinions and people's behaviour in a specific context, every contribution is important and no information should be discarded on the basis that only one person mentioned it. Therefore, it was important to verify the findings from the expert perspective and to elicit their experiences in the given context. Expert reviews were used mainly to review and validate the proposed model from the cycles of drafts until the final model was formulated, as presented in this study.

The main objective of using experts reviews was to: firstly, elicit the general components for a quality model that would aid successful implementation of ICT solutions, especially those

relating to rural areas; the challenges relating to the implementation of the existing models and methods in solutions development; and lastly, as the reviewers of the GQAM to ensure that fundamental elements and applicability within the field of solutions development is maintained.

Therefore purposive sampling was used to select the experts, making sure that different fields of expertise relevant to the study are represented; hence were have experts from these different fields, ensuring that the different interpretations and perceptions of quality are covered on all ends. Thus, experts were selected based on their experience within solutions implementation projects (more than 5 years experience in the field, with direct involvement in the solution implementations projects within the past 2 years).

Experts in the medical research, QA, project management, systems development and ehealth fields were consulted to participate in a series of interactions in the QA model development process of this study; the researcher has refined the questions with each interaction to converge on the central issues or themes in QA to develop an appropriate QA model (Cooper & Schindler, 2006: 209). Their knowledge was elicited to ascertain the requirements and review the models developed until the final GQAM was subsequently arrived at. The use of expert reviews was intended to validate the model and the findings and results of the various layers of building the model, and guidelines for implementing the model. This process adds to the reliability and validity of data.

The subsection below outlines the cycles that through which the model was developed.

4.2.5.3.2 Sub-phase 3.2: Model development cycles

This process continues until the desired outcome is reached. It is a process of implementing the developed theory in practice and validating the outcomes to observe whether the problem has been solved. Figure 4-4 highlights the process followed.


Figure 4-4: Summary of model development process.

As has been stated (*cf* chapter 4), the case studies formed the basis of some of the cycles in the study, therefore the data collected from the case study (through the research subquestions) were analysed and used as input for the first cycle, as shown in Figure 4-4. When the first cycle was completed a draft model was produced and used as input to the second cycle. The draft model was reviewed by the study participants and the experts in the project quality management and solutions design field. The cycle continued until the final model was produced. This was then viewed so as to be generic to all cases involved.

Within these series of model development cycles, interviews and reviews were carried out to ensure that all the complexities and challenges relating to QA were considered and covered by the model. The participants involved in the review cycles of this framework included the e-health team, senior management, the project manager and coordinators, user representatives, the IT directorate, vendors and suppliers, and various experts from the industrial fields of quality management, project management, senior management, solution design, business analysis and solution QA, and experts in the academic field of quality. The model started with a draft of the final model involving several cycles, which are presented below in stages, as adapted from Baskerville and Myers (2004) who indicate that there are primarily two stages involved, the diagnostic stage and the therapeutic stage.

Table 4-5: Model development cycles

	Cycle 1	
Diagnostic stage	Therapeutic stage:	
 Analysis of the findings Identify the gaps of the current methods Define elements of the model Select participant's representatives in the model reviews Select tools and techniques to represent the model 	 Identify key themes that need to be addressed Link elements to the identified challenges and gaps Identify and contact key role players Combine key elements of the model into topics 	
	Outcomes	
Draft QA model developed and communication	nunicated	
	Role players	
 Researcher, and the selected participal 	nts	
	Cycle 2	
Diagnostic stage	Therapeutic stage	
 Model reviews Email key communication method Telephone interviews Telecon presentation Participant visits Feedback analysis Identify gaps in the model 	 ✓ New themes and topics emerged ✓ Topic consolidation based on knowledge area ✓ Layers of the model developed 	
	Outcomes	
QA model updated with lavers and com	nmunicated for reviews	
	Role players	
 Researcher and the selected participar 	ts	
	Cycle 3	
Diagnostic stage	Therapeutic stage	
 Model reviews Generic context fit checks 	 Model updated with changes focused on presentation and understandability: Legend creation & Picture graphics changes 	
	Outcome	
Generic QA Model (GQAM) for e-healt	n solutions	
	Role players	
 Researcher and the selected participar 	Its	
	Cycle 4	
Diagnostic stage	Therapeutic stage	
 Applicability of the model Selection of a methodology for representation Reviews 	 Model decomposed into GQAM framework Activities linked to key deliverables Activity and deliverable mapping to GQAM value chain Value chain applied on SDLC phases 	
	Outcomes:	
A value-chain implementation guide	eline developed, study documentation	
Role players		
 Researcher, selected participants and 	the study supervisors	

Table 4-5 shows that this study occurred in four cycles, during which the GQAM was developed over time, until finally the model's QA value chain implementation guidelines were drawn up. As has been stated, the study findings were used to initiate the model development cycles, in terms of which several diagnostic and therapeutic stages were adopted. At the end of cycle 1, the first draft of QA model was obtained from the reviews and a discussion of the gaps in the model. Subsequently, changes were made over time until the final model was produced in cycle 3. This model, the GQAM, was used as the input to the fourth cycle, where the QA value chain implementation guidelines were produced to aid in the implementation of the GQAM. Hence, these stages and the model development cycle are summarised in Figure 4-5.



Figure 4-5: Summary of the model development cycles

A GQAM (*cf.* chapter 6) was formulated by triangulating the data obtained from the findings of the extensive literature study and the research findings – answers received to the research sub-questions, and the expert reviews. These were used as input for each of the cycles through which the model went until it reached its final form, as depicted in Figure 4–5.

4.2.5.4 Phase 4: Final model documentation

Step 8:

The final GQAM was produced in phase 4 and was used as input to the cycles for developing a QA value chain and, finally, the GQAM implementation guidelines.

Step 9:

The final versions of the GQAM and its implementation guidelines were documented and included in the chapters of this thesis.

4.3 SAMPLE IDENTIFICATION AND SELECTION PROCESS

This section focuses on the sampling design and how the participants were selected.

4.3.1 Sampling design

After formulating the research question, the researcher identified the sources of the phenomenon being studied. Firstly, hospitals in the Eastern Cape were selected that have implemented the five e-health solutions and were serving the rural community. Individuals who were willing to describe their experience(s) in terms of the phenomenon in question were identified and included in the research sample. Using the ethical informed consent form (*cf* Appendix D); it was ensured that these individuals understood what was involved and were willing to relate their experiences.

As indicated in chapter 1, the main concern of this study was to develop a GQAM for the successful acquisition of e-health solutions in rural hospitals in the Eastern Cape Province

to improve the quality of care and service delivery. Therefore, the research activity was aimed in part at finding out how stakeholders involved in e-health acquisition projects articulate notions of quality, experience currently adopted QA methodologies, maintain support for and view the shortcomings in e-health acquisition, especially in rural areas.

According to Goodwin (2002: 398), a sample must be representative if it is to be regarded as valid. Purposive sampling was applied, in this study, to sample the various hospitals and participants. Hospitals surveyed were those serving rural communities and using the five ehealth solution programme implemented by the ECDoH. Only hospitals providing primary care and that were generally the point of first entry for patients in the different regions (the former Transkei and Ciskei) were surveyed. Research participants included developers, analysts, project managers, users, business, managers, doctors, nurses, ECDoH officials and the QA team members. According to Babbie (2005: 189), purposive sampling involves the selection of the units to be observed on the basis of one's own judgement about which ones will be the most useful or representative. Purposive sampling is also called judgemental sampling.

While each data source could provide valuable information on the selected indicators, care was taken in deciding which data sources would be best for which type of information. In addition, many data sources were strengthened by some preparatory work. The informed consent (*cf* Appendix D) ensured the latter, as a good explanation of the purpose of the research project and clear and concise instructions for completing the questionnaire all enhanced the validity of the data. Ensuring that the participants knew the purpose of the study improved the validity and accuracy of the assessment results (Marshall & Rossman, 1995: 67).

Cooper and Schindler (2006: 402) state that the basic idea of sampling is that, by selecting some of the elements in a population, conclusions may be drawn about the entire population. According to Welman and Kruger (2005: 47), the sample must be representative. This means that the sample has to have the exact properties in the exact same proportions as the population from which it was drawn, but in smaller numbers.

Sampling consists of two types of sampling method, which are discussed briefly below (Babbie, 2005: 188):

- Non-probability sampling: This is any technique in which samples are selected in some way not suggested by probability theory. Examples include reliance on available subjects and purposive (judgemental), snowball and quota sampling. These types of non-probability sampling can be defined as follows:
 - Reliance on available subjects. This is an extremely risky sampling method, which does not permit any control over the representativeness of a sample. It is only justified if the researcher wants to study the characteristics of people passing the sampling point at specified times and should only be used if less risky sampling methods are not feasible.
 - Purposive or judgemental sampling. In this type of sampling the units to be observed are selected on the basis of the researcher's own judgement about which will be the most useful or representative.
 - Snowball. A sampling method often employed in field research in which each person interviewed may be asked to suggest additional people for interviewing.
 - Quota sampling. This sampling method selects the units to be included in the sample on the basis of pre-specified characteristics so that the total sample will have the same distribution of characteristics assumed to exist in the population being studied.
- Probability sampling: This is the general term for samples selected in accordance with probability theory, typically involving some random-selection mechanism. Specific types of probability sampling include simple random sampling and systematic sampling. These types of probability sampling can be defined as follows:
 - Simple random sampling. In this sampling method each element has an equal chance of selection independent of any other event in the selection process.

 Systematic sampling. In this sampling method every kth unit in a list is selected for inclusion in the sample.

This research study employed two steps in selecting the participants:

- 1. A non-probability sampling method of purposive sampling was applied in that the population group was selected to fit the purpose of this study.
- 2. Participants from within the sampled cases were selected on the basis of their knowledge and involvement in project implementation.

4.3.2 Participants

Cooper and Schindler (2003: 322) state that, even if individuals agree to participate, they may not possess the knowledge being sought. If participants are asked to report on events that they have not personally experienced, their replies need to be assessed carefully. However, if the purpose is to learn what the participant understands to be the case, it is legitimate to accept the answers given. Cooper and Schindler (2003: 323) go further by stating that if the intent is to learn what the event or situation actually was, one can recognise that the participant is reporting second-hand data and the accuracy of the information declines. If a more direct source can be found, less dependence should be placed on the second-hand sources.

As indicated in the above section, purposive sampling was adopted to select the participants to achieve the goals of this study and elicit the information required. Table 4-6 shows the different cases (hospitals) and the list of e-health solutions that were studied:

Case no.	Case description (Hospitals)	Location/City	Solutions
1	St Patrick's Hospitals	Bizana	 TeleDermatology TeleECG/Spirometry
2	Madzikane ka-Zulu Memorial Hospital	Mount Frere	 Teleconsultation Mindset

Table 4-6: Case study list

3		Uitenhage	5.	Telemedicine
J	Uitenhage Hospital			
		Grahamstown		
4	Settlers Hospital			
F		Queenstown		
5	Frontiers Hospital			

As shown in Table 4–6, this study included five cases where similar e-health solutions (TeleDermatology, TeleECG, Teleconsultation, Mindset, and Telemedicine) were implemented. It is evident that the specific multiple cases/hospitals were selected on the basis of these solutions. If these solutions had not been present, the hospital would have fallen outside the parameters of the sample.

Participants in these five cases included senior management, project managers and coordinators, the IT directorate and e-health team representatives from the ECDoH. Representatives from the vendors of the solutions, the solution user community based at the five hospitals were included. The user community comprised doctors, nurses, radiographers and other hospital staff. This included only those who were involved within the processes of acquiring the selected e-health solutions within the selected hospitals and they represented the members of the project team for systems acquisition and for QA within the project. Apart from the project quality management fields, both in industry and academia, were involved. These experts were used mainly at the end to verify the model developed during phase three. Table 4–7 summarises the participants involved in all phases of the study.

Study Participants		
Category	Total N	
Vendors	3	
ECDoH	6	
Site coordinators	5 (N=1 per case)	
Users (doctors, nurses, radiographers, etc)	15 (N=3 per case)	
Expert reviews	6	
Total	35	

Tahle	4-7.	Total	narticinants	
Iable	H-1.	TUtai	participants	

*Eastern Cape Department of Health (ECDoH)

In total, there were 35 participants from the five rural hospitals in the Eastern Cape Province, from which the data were collected over a period of 18 months. The data interpretation and analysis approaches adopted in this research study are discussed in the next section.

4.4 DATA ANALYSIS AND SYNTHESIS

According to Babbie (2005: 387), the interpretation of data collected during qualitative research (non-numerical examination and interpretation of data) is not as impersonal as that of quantitative research. For the purpose of this study, it was important to interact with persons and processes to create and construct knowledge as the process continued. The interpretation of results ultimately offers the researcher's personal views (Stake, 1995: 29).

The process of interpretation aims to identify patterns in phenomena and create models to help to understand the issues at hand. Another characteristic of qualitative research is its holistic nature. All phenomena that are studied are related through actions and contexts, which have to be incorporated in the interpretation of data (Stake, 2000: 43). Schumacher and McMillan (1993: 102) describe the analysis and interpretation of data as follows:

- Analysis is the "resolution of a complex whole into its parts".
- Interpretation (synthesis) is the "construction of a whole out of parts".

According to Mouton (2005: 108), all fieldwork culminates in the analysis and interpretation of some set of data, be it quantitative survey data, experimental recordings, historical and literary texts, qualitative transcripts or discursive data. Mouton (2005: 108) goes further by saying that analysis involves breaking up data into manageable themes, patterns, trends and relationships. The aim of analysis is to understand the various constitutive elements of the data through an inspection of the relationships between concepts, constructs or variables, and to see whether there are any patterns or trends that can be identified or isolated, or to establish themes in the data.

According to Mouton and Marais (1991: 111), the variables that are relevant to an event are isolated by means of analysis and interpretation is used to reconstruct the relationships

between the variables to give insight into the causal factors associated with the events. Mouton and Marais (1991: 111) further state that data may be collected and systematically examined by means of deductive and inductive strategies. Inductive strategies gradually confirm support for prior postulations while deductive strategies lead one to make postulations on the basis of evidence. In either case, the truth of the conclusion (postulation) is implicitly or explicitly contained in the premise (Mouton & Marais, 1991: 111).

Creswell (2007: 148) maintains that data analysis in qualitative research consists of preparing and organising the data for analysis, t reducing the data into themes through a process of coding and condensing the codes, and finally representing the data in figures, tables, or a discussion. According to Creswell (2007: 191–195), there are common steps involved in the analysis and interpretation of qualitative research data. These steps are highlighted in Table 4-8.

Steps	Description
Organise and prepare the data for analysis	This involves transcribing interviews, typing up field notes,
	or sorting and arranging the data into different types
	depending on the source of information.
Read through all the data	This involves making sense of the information and
	understanding the meaning of the data as a whole.
Use the coding process to generate a	This involves collecting detailed background information
description of the setting or people, as well	about people, places or events in a setting.
as categories or themes for analysis	
as categories or themes for analysis Steps	Description
Steps Use the coding to generate a small number	Description These themes are the ones that appear as major findings
Steps Use the coding to generate a small number of themes or categories	Description These themes are the ones that appear as major findings in qualitative studies and they are stated under separate
Steps Use the coding to generate a small number of themes or categories	Description These themes are the ones that appear as major findings in qualitative studies and they are stated under separate headings in the finding sections of the study.
Steps Use the coding to generate a small number of themes or categories Advance an example of how the description	DescriptionThese themes are the ones that appear as major findingsin qualitative studies and they are stated under separateheadings in the finding sections of the study.The most popular approach is to use a narrative passage
Steps Use the coding to generate a small number of themes or categories Advance an example of how the description and theme should be represented in the	DescriptionThese themes are the ones that appear as major findingsin qualitative studies and they are stated under separateheadings in the finding sections of the study.The most popular approach is to use a narrative passageto convey the findings of the analysis.
Steps Use the coding to generate a small number of themes or categories Advance an example of how the description and theme should be represented in the qualitative narrative	Description These themes are the ones that appear as major findings in qualitative studies and they are stated under separate headings in the finding sections of the study. The most popular approach is to use a narrative passage to convey the findings of the analysis.
Steps Use the coding to generate a small number of themes or categories Advance an example of how the description and theme should be represented in the qualitative narrative Interpretation	DescriptionThese themes are the ones that appear as major findingsin qualitative studies and they are stated under separateheadings in the finding sections of the study.The most popular approach is to use a narrative passageto convey the findings of the analysis.This explains the meaning of the data.

Table 4–8:	Common	data	ana	lysis	steps
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Source: Creswell (2007: 191–195)

This study adopted the processes mentioned in Table 4–8 to present a qualitative analysis of the collected data, and these are incorporated into the results (*cf* chapter 5). According to Leedy and Ormrod (2001), content analysis is "the detailed and systematic examination of the contents of a particular body of material for the purpose of identifying patterns, themes or biases". Myers and Avison (2002) describe a form of content analysis known as open coding, where data are categorised into concepts that are implied by the data (Leedy & Ormrod, 2001; Welman, Kruger & Mitchell, 2005; Woszczynski & Whitman, 2004). Once categories and themes have been established, interconnections or relationships are identified between these categories and subcategories based on their context (Leedy & Ormrod, 2001; Woszczynski & Whitman, 2004). Categories and themes and their interconnections are continually refined as additional data are collected (Welman *et al.*, 2005). This approach was used to analyse the interview data obtained and an analysis was done for each focus group. This formed the basis for chapter 5 in which the findings are discussed.

Merriam (2001) provides a more integrated process in which qualitative data analysis can be categorised on three levels:

- Descriptive level. This is the first level of analysis and is the most basic. This level was used to integrate and analyse the collected data in a manner that was meaningful. Descriptive statistics assist the researcher to understand more about the research; in short these assisted the researcher to organise and summarise the data using tables and graphs, especially for the closed questionnaire (see Figures 5.1 and 5.2) (Trochim, 2006).
- **Category construction.** At the end of each case study, categories of themes that occurred throughout the data were constructed. These themes conserved the key QA elements that need to be considered when developing a model.
- **Development of theory.** This level was the last level of analysis in which a QA model for e-health acquisition for the rural areas was developed.

As multiple case studies were used in this study, each case had to be analysed and t a crosscase analysis had to be done. This aimed to build abstraction across cases – a general explanation that fitted each of the individual cases even though the cases varied in their details (Yin, as cited by Merriam, 2001: 195). For the purpose of this study, descriptive statistics were used to summarise and explain the data. Data triangulation was done to draw conclusions from the results and to prove that what is discussed from a descriptive perspective is accurate and reliable. The trustworthiness and reliability of the results are discussed in the next section.

4.5 TRUSTWORTHINESS

Validity and reliability or the trustworthiness of qualitative research lies in the accurate assessment and interpretation of research data (Merriam, 2001: 199). Therefore, much of the validity of qualitative research is gained through reliability in the data collection phase of the research. This can be supported by probing the reliability, internal validity, external validity of a qualitative study (Stake, 1995: 107–120; Babbie, 2005: 144–151).

4.5.1 Reliability

According to Cooper and Schindler (2006: 321), a measure is reliable to the degree that it supplies consistent results. Reliability describes whether or not the results can be replicated (Babbie, 2005: 145) on another occasion and/or by different researchers (Saunders *et al.*, 2000: 100). This is difficult to prove in qualitative research, which is about people and their views of their current reality. In this research, therefore, the dependability and consistency of results were proven by explaining the researcher's position and assumptions, the groups studied, the selection basis, and the multiple methods of data collection and analysis within the different case studies.

Reliability is the degree to which the finding is independent of accidental circumstances in the research, and validity is the degree to which the finding is interpreted correctly. Reliability is a necessary contributor to validity but is not a sufficient condition for validity (Cooper & Schindler, 2006: 321).

4.5.2 Validity

Validity refers to the degree to which the finding is interpreted correctly. The validity of the study should be probed in terms of two validity variables:

- Internal validity is the ability of the research instrument to measure what it is purported to measure (Cooper & Schindler, 2006: 321). It is a depiction of how the research findings match reality, especially since qualitative research describes people's constructions of their own worlds, which are ever-changing. In this study, validity was enhanced by the use of triangulation (using sources and methods to confirm this study findings), convergence (using experts in the field to review and comment on the findings), participant checks (taking the data and interpretations back to the origin continually during the study), long-term observation, peer examination (colleagues' comment on findings as they emerge), and participatory or collaborative modes of research.
- External validity questions whether or not the findings of one study can be generalised or applied to another situation (Saunders *et al.*, 2000: 102). Cooper and Schindler (2006: 318) state that the external validity of research findings is the data's ability to be generalised across persons, settings and times. This study has considered local conditions and offers the reader some guidance in making decisions, as Stake (1995: 107–120) states that owing to the developmental character of qualitative research, the results should not be seen as a conclusion, but as a working hypothesis. The multiple case studies used for the study maximise diversity in the phenomenon.

Since the phenomena studied in this research were so complex, it was attempted to minimise misinterpretations. This study strategy, case studies, relies heavily on social constructivism paradigm, and to strengthen the trustworthiness of the research results, triangulation was applied, and is discussed below.

4.6 DATA TRIANGULATION

According to Jick (1979) data triangulation refers to the combination of methodologies used to study the same phenomenon. The use of the different methods helps ensure that the

variance reflected is the result of the trait rather than the research method. Hence, the results will be valid and not the outcome of a methodological artefact (Jick, 1979). According to Van Greunen (2009), when combining primary with secondary data the outcome is data triangulation, as it provides the opportunity to verify findings (e.g. piece of data, generalisation etc) by using several different research methods. As a result, this adds more credibility and value to the findings (Weinberg & Driscoll, 2006). In this study, data triangulation played an important role aiding the analysis and presentation of the data in its most reliable, valid and accurate form.

In many instances, it is unlikely that a single measure will adequately assess the extent to which a programme objective is attained, especially when the objective entails complex and multifaceted knowledge and skills (Creswell, 2007: 121). This is due to the fact that each research method has its own advantages and disadvantages. It makes more sense to use a number of different methods. In such cases, the use of multiple measures and approaches will enhance the validity, reliability, equity and utility of the data, and the decisions about the phenomena (McMillan & Schumacher, 1993: 43). Data triangulation offers the opportunity to use the strong points of the various research methods and combine them to collect the data (Hofstee, 2008).

According to Zuber-Skerritt (1997) and Stake (1995: 107–120), there are various types of triangulation:

- Data source triangulation is applied if results from data of different settings, times, locations or levels (individuals, groups or whole organisations) are compared. In this research, where a case was the source of a complex collection of data, the question was whether the results would carry the same meaning if interpreted for other cases.
- Methodological triangulation occurs when results from different methods or techniques are compared. In this research, observation, participation, document analysis, interviews, surveys, questionnaires, expert reviews and literature reviews were used to reach final conclusions. Some quantitative results were incorporated to strengthen the qualitative process.

In this study the above triangulations were used; however, the methodological triangulation is the most common approach. There are three basic types of methodological triangulation (Hofstee, 2008):

- 1. One researcher using two or more research techniques.
- 2. Two or more researchers using the same research technique.
- 3. Two or more researchers using two or more research techniques.

This study adopted the first type of methodological triangulation, a researcher using two or more research techniques, as shown in t Figure 4-6.



Figure 4-6: Triangulation summary

In this study a combination of quantitative and qualitative research methods were used. The aim of quantitative methods is to measure (quantify) the relationship between two or more items and to attempt to present it in a statistical or numerical format. Qualitative data, on the other hand, aims to identify the quality of the relationship that exists between two or more items. This relates directly to the researcher's intention to make sense of the interpretations, and to assign meaning to the way people do and understand items (Hofstee, 2008). Many

experts believe that quantitative and qualitative methods should be used together to complement one another, rather than to rival each other (Jick, 1979).

Creswell (2007: 124) avers that the purpose of triangulation is to ensure that the research findings reflect people's perceptions accurately and help researchers increase their understanding of the probability that their findings are seen as credible or worthy of consideration by others. Triangulation is a general method for bringing together different kinds of evidence into some sort of relationship with one another so that the evidence can be compared and contrasted. In comparing different accounts, the points where they differ, converge and diverge allow insights and new understandings to be developed (Elliot, 1991; McFee, 1992).

4.7 LIMITATIONS OF THE METHODOLOGY

The evaluation of QA methods and processes used in the five hospitals selected in the Eastern Cape Province was based on the five e-health solutions accurately and focused only on quality issues relating to project management for solution acquisition other than the quality processes at organisational, procurement and logistics, and operational levels. The questionnaires and interviews were used to triangulate the data and complex statistical analyses using techniques such as Cronbach's coefficient alpha and *t*-tests were not carried out. The data analysis aimed to understand aspects relating to QA existence and its use in the e-health acquisition projects and did not evaluate the appropriateness of the processes used or the efficiencies of documents. Only a limited number of industry and academic experts were used in the expert reviews for model development.

4.8 ETHICAL CONSIDERATIONS

As stated in chapter 1, this research has ensured that no unethical issues arise, as various ethical approaches were considered (cf 1.7).

The literature in the field of research methods reveals that the key ethical considerations in a research study are informed consent by research participants and the research participants' right to privacy and protection from harm (Leedy & Ormrod, 2001; Welman *et al.*, 2005). Welman *et al.* (2005) emphasises that researchers should guard against manipulating research participants or treating them as numbers rather than human beings. Some disciplines have professional codes of ethical standards governing research that involves human subjects. For this study, consent was obtained from each participant to conduct the survey and interviews and to use the data collected. In order to ensure the anonymity of the research participants, they are identified by "Respondent" combined with a numeral. In addition, ethical approval was obtained from the Eastern Cape Department of Health before contacting the participants for this study (*cf* Appendix C).

4.9 CONCLUSION

In this chapter the methodologies and research designs used in this study were discussed and a blueprint adopted for eliciting information appropriate for fulfilling the goals of this study and answering the research questions. This chapter has revealed that qualitative and quantitative methods, using multiple case studies, were used as the primary method. To ensure the reliability and validity of this study, measures were put in place to ensure that research data were collect and interpreted accurately by using multiple sources and method triangulation.

As this project involves participants and confidential information, unethical issues were avoided and the research was conducted in such a manner that these issues were prevented from arising. This chapter provided a map showing how the research findings, discussed in the next chapter (chapter 5), were reached; it facilitates the decisions and recommendations of the study which are discussed in chapters 5 and 6.

5 QUALITY ASSURANCE METHODS FOR E-HEALTH

5.1 INTRODUCTION

This chapter presents the findings, and an analysis and interpretation of the data obtained by means of the data collection instruments (a questionnaire, literature review, interviews, document analysis and expert reviews) used during this study. The data were analysed and interpreted to address the first three research sub-questions (sub-questions 1–3; *cf* chapter 1), which will later be used to answer the main research question, resulting to GQAM development (*cf* chapter 6).

5.2 ADDRESSING THE RESEARCH QUESTIONS

The main research question addressed during this study is as follows:

What are the components of a generic quality assurance model (GQAM) to assist rural hospitals in the Eastern Cape Province with the successful acquisition of e-health solutions?

In order for the data collection instruments to be effective, the main research question was broken down into sub-questions and different measuring instruments were applied.

The research method took the form of a multiple case study; this method was chosen because it allows in-depth research on the subject using various data collection methods such as questionnaires and interviews. Table 5–1 gives a summary of the sub-questions and the data collection instruments used to answer the sub-questions.

Table 5-1: Data collection plan

	SUB-QUESTION	QUESTIONNAIRE	INTERVIEW	EXPERT REVIEWS	DOCUMENT ANALYSIS	OBSERVATION	LITERATURE
1.	What are the QA methodologies used in e-health acquisition for rural hospitals?	~	~		~		
2.	How do these methodologies aid successful e-health acquisition in rural hospitals?	~	~	~			
3.	What are the challenges experienced when applying these methodologies in rural hospitals?	~	~	~		~	
4.	What sensible model can be adopted to overcome these challenges and to improve the QA processes used in e-health acquisitions in rural hospitals?			~			~

The following section discusses the research findings obtained by means of the data collection instruments, namely the questionnaire, the interviews and the literature study.

5.3 RESEARCH FINDINGS

In the following subsections, the findings of the research sub-questions are discussed starting with the first sub-question.

5.3.1 First research sub-question

The purpose of this research sub-question is to investigate the existence of QA methodologies and how the participating organisations (e-health solution vendors and

ECDoH) make use of QA methodologies during e-health solutions acquisition projects in order to ensure that a quality product is delivered.

What are the QA methodologies used in e-health acquisition for rural hospitals?

The data collection methods used to answer this sub-question were the questionnaire, interviews and document analysis (*cf* Table 5-1). A detailed discussion of the findings relating to the first research sub-question is provided below, starting with the results collected through the questionnaire.

5.3.1.1 Questionnaire findings

The questionnaire was completed by nine of the 35 participants in this study. Section 4.2.5.2.1 provides an overview of the questionnaire structure. In this section feedback is given on the specific sections that answer the first research sub-question. The detailed questionnaire is available in Appendix A. The questionnaire (*cf.* Appendix A) consisted of 11 main topics designed (as indicated in section 4.2.5) to obtain information on how QA was applied during the acquisition projects of the selected e-health solutions at the five rural hospitals in the Eastern Cape Province that had agreed to participate in the study. These topics were grouped into four sections (section A–D) based on their relevance and relation.

The section of the questionnaire on general quality management in the organisation (topic-1) and its propagation to project quality management were used to answer the first research sub-question; later the overall feedback for the relevant topics (topics 2–10) is discussed. In the table below are the questions asked relating to the first topic (general QA background).

Table 5-2: Questions relating to topic-1

Question No.	Question
1	Does a quality management system exist within your organisation?
2	Does a quality management strategy exist, which addresses the strategy to be followed during system implementation/development projects?
3	Has this quality management strategy been compiled taking into account QA standards, such as ISO 9000: 2000, PMBOK, PRINCE2 and CobiT?
4	Is there an adopted quality manual, which indicates the quality activities to be followed during a system implementation/development project?
5	Do the activities stated as part of the QA function's responsibility address the key quality principles?
6	Is there a quality forum responsible for quality approvals and evaluations? Is there a database or store for lessons learnt for projects?

The responses to the above questions were analysed and presented in tables and graphs. These tables and graphs display the summaries on the actual responses to all the items in the questionnaire relating to this sub-question. Below are key concepts elicited from the participants relating to the first research sub-question.

General quality management

As depicted in the figure 5-1 below, it is evident that a quality management system, strategy and the quality forum exist, as all (100%) of the nine participants have responded "yes". Even though this is the case, the findings depicted in this figure show that there seems to be a lack of awareness of the applicability of those strategies to the projected levels, as more than 55% of the participants have shown that they are not sure whether the existing system and strategies on quality are compliant or aligned with any standards. This becomes even more evident as in excess of 77% of participants were not aware of the existence of any quality manuals to guide QA in the implementation of and compliance to the quality strategies in the daily operations, as well as ensure quality by stating the key quality principles throughout the project and solution lifecycle. This may be due to the lack of a knowledge base and lack of access to information about previous experiences on such projects. Seventy-seven percent of participants stated that that there is no existing database of lessons learnt in their organisations that they are aware of.





It can therefore be concluded from this topic (topic 1) that QA methodologies exist in the participating organisations, as seen in figure 5-1. However, there is much to be done to promote awareness of these methodologies for guiding QA at project level, such as the development of a quality manual or policy with detailed QA principles and standards that have to be followed. It would also be useful to have a "lessons leant" knowledge base, where all the lessons leant from projects can be stored to aid success and provide points of reference in future projects.

To support this conclusion on this sub-question as the findings of topic-1 have shown above, figure 5–2 below gives a graphical representation of the answers received regarding the other relevant topics for the first research sub-question (topic 2-10).



Figure 5-2: QA in projects

Figure 5–2 above shows that there is a QA methodology, with certain relevant topics and weaknesses. The following table, table 5–3 summaries the key findings shown in figure 5–2 in relation to this sub-question:

Table 5-3.	Questionnaire	findinge	on c	sub-question	1
Table 5-5.	Questionnane	innunngs	UII S	sub-question	•

Topics	Findings summary
Customer involvement	There seems to be higher involvement and firm relationships between the suppliers
during the project	and the department, and a level of involvement between the parties (39% agree
	and 3% of the participants strongly agreed). However, the findings show a lower
	level of involvement of the hospitals in which these solutions are implemented, as
	only one person is involved, referred to as site coordinator, and mostly their
	involvement is during the pilot phase of the solution, when all the decisions,
	requirements, and designs and developments have been completed. Hence, 32%
	of participants totally disagree with questions related to involvement at the user
	level, while 26% of participants were not happy with the existing levels of
	involvement, thus they indicated they "neither agree nor disagree".
Quality upfront	Although there is a consensus that there is some level of quality upfront in activities
	(35% agree and 2% strongly agree), all the participants showed the need for
	improvements, especially in the areas of project plans, quality plans, and the roles
	and responsibilities, as those scored very low on the questionnaires (19%

	disagreed and 44% neither-agreed nor-disagreed).
	Since most of these solutions were packages – from the supplier's side – quality
	upfront scored higher for all the solutions.
Project management	A fair level of project management discipline was applied during the project (53%
discipline	agree); however, some improvements would enhance discipline especially in the
	areas of quality management, QA and reporting (24% disagree and 23% neither
	agree nor disagree).
Traceability	Traceability appeared not to be sufficiently applied during the project; most of the
	participants (32% disagree and 38% neither agree nor disagree) indicated the lack
	of awareness of most of activities alluded to in this topic. Less than 30% indicated
	that there were some elements of traceability within projects.
Continuous	Although the participants indicated the existence of continuous improvement in
improvement	projects (36%), there is a consensus that the continuous improvement of processes
	was not sufficiently applied throughout the project (32% disagree and 32% neither
	agree nor disagree).
Independent QA	Although some project reviews have taken place (46% agree), reviews were not
	always specific to QA but rather generic project management, such as schedule
	and resources issues. Hence, 41% of participants indicated that they "neither agree
	nor disagree" and 13% disagreed with some items in this topic.
Qualified staff	The team consisted of highly skilled staff, as the findings show that 52% of
	participants agree. This is mostly from the supplier and management point of view
	but challenges exist in the users' sites and on the ECDoH side. The findings reveal
	that there was no business analyst, QA team or project manager from the DoH.
	However, the project coordination team took responsibility for these roles, in
	addition to their own roles. Hence, 40% of participants indicated that they "neither
	agree nor disagree", while only 8% disagreed.
Clear accountability	Clear accountability was seen to be lacking in most solutions projects, according to
	44% of participants who disagreed, while 38% agreed that there is accountability in
	projects and 18% neither agreed nor disagreed. Some improvements were
	indicated as being necessary for the pilot phases and site sustainability.
Use of QA tools and	It was found that there is use of QA tools and techniques throughout the project, as
techniques	43% agree, while 24% of the participants indicated that they were not using such
	tools, and 33% "neither agree nor disagreed" as they were not aware of such tools
	and their use within their organisation or in the e-health project.

The findings of the questionnaire reveal that there is a quality management system in place in the organisations involved in e-health solution acquisitions for rural areas. It is evident that these organisations currently used QA methodologies during e-health solutions acquisition, as most of the quality principles surveyed received positive feedback. However, some areas need improvement, such as customer involvement, traceability, continuous improvement, independent QA, quality up-front, qualified staff, accountability, and QA tools and techniques.

The next subsection discusses the findings obtained during the interviews.

5.3.1.2 Interview findings

The findings from the interviews showed that there was general consensus on the existence of QA methodologies adopted. This was supported by the findings from the questionnaires, which made it clear that, from the vendor side, which had quality management systems that are aligned with quality principles and standards, such as ISO were adopted and they are ensured during the solutions development phases. This appeared to be a result of the contracted vendors being global organisations that are governed by international regulations on medical equipment development and these organisations are ISO certified. The extracts from the interviews provided show a few of the responses that are relevant and appropriate to this question.

"Our products must pass through a chain of quality evaluations, and a continuous quality assurance methodology is used throughout the organisation" (Respondent 1).

"Since we provide critical systems that can help or jeopardise the health provisioning based on its effectiveness; our organisation is ISO certified and we have a rigid QA methodology to ensure that we produce quality solutions" (Respondent 2).

"Quality management system exists within the organisation but it is not fully monitored and evaluated, so whether it's used or not is not necessary assured" (Respondent 3). "The quality assurance does exist, but I don't seem to find it enforced on e-health solutions; may be its due to the fact that fewer people are aware of it" (Respondent 4).

As discussed in section 4.3.2, the questionnaire respondents included participants from the ECDoH, where the e-health team acts as a driver for e-health acquisition projects. They provide and govern the processes and methods for solution implementation and the project team members for the implementation projects. From their responses, it was clear that although there is a generic quality management system within the ECDoH, there seems to be a need for a strategy guide for project implementation levels. From the interviews conducted, it was found that their existing methods are lacking in the areas of accountability, QA and continuous improvement, and support for sustainability and maintenance. These specific items and their feedback from the interviews are discussed.

• Accountability

The responses reveal that although the process for implementing the solution was in place and QA activities for the solutions were taken care from a technical point of view regarding "requirement conformance" (*cf* chapter 3), this process overlooked the non-technical "fit-foruse" aspects of quality (*cf* chapter 3). This led to confusion and ineffective use and acceptance of solutions in most instances. The lack of clear accountability in terms of resources and the limited information of the contact persons either for technical support or medical expertise to which the solution aimed to achieve evidenced to impose challenges on the use of the implemented solutions, which lead to some solutions being ignored.

Furthermore, the future accountability in terms of financial support and maintenance of the solutions was not accounted for within the process of implementing the solution, leading to local management in hospitals not being aware that after a certain period the solutions would depend entirely on their management and budgets for continuity and maintenance. The following are the key abstractions. It is important to note that, owing to ethical considerations, some key inputs can not be reported on, however, but care was taken to

ensure that participant's views and user's challenges were addressed in the discussions of this study:

"The solutions were implemented, but we don't know exactly who we sending the data to and how we can contact the person, especially on urgent cases" (Respondent 1: Case 2).

"The channel was not clearly set as part of the project, as to who is doing what and who to talk to for specific needs" (Respondent 2: Case 1).

"There are so many people one has to contact before getting help; can't we have a reliable channel?" (Respondent 3: Case 3).

• Independent quality assurance

Independent QA within a project is planned for in the initiation of the project and is carried through in the various phases or deliverables of the project to ensure that its process, activities and deliverables are executed as planned and meet the expectations of the project stakeholders at its end . This independent QA forms part of continuous improvement processes within and after project implementation. The findings reveal that the elements of independent quality and project evaluation exist during the development of the solutions and for the technical testing and verifications of the solution functionality. However, there were no evaluations done for the overall project process or deliverables during the project and even more serious, after the solution had been deployed. This lack of evaluation led to the solutions deployed being ineffectively used or, in the worst cases, not used at all. This was found to be the case with certain e-health solutions in these hospitals, as shown in the interview extracts:

"There is a solution that was never used, and none has ever asked about it" (Respondent 1: Case 3).

"The Teleconsultation solution was deployed but was never used nor did anyone tell us how it's used" (Respondent 2: Case 5).

"Teleconsultation solution has been here since 2006, but was never connected and we tried but none seems to know how to use it" (Respondent 3: Case 4e).

'It would help to have some more reviews during the process to ensure that quality is met" (Respondent 4: Case 1).

• Sustainability and maintenance

Sustainability is the key issue and poses common challenges for solutions in developing countries (as indicated in chapter 2). From this study finding, it was confirmed that sustainability and maintenance issues exist in the selected e-health solutions. However, it is important to note that, in spite the challenges posed by unreliable power supply and infrastructural limitations, most of the problems highlighted could have been resolved if QA had been appropriately applied during the project cycles. Key issues linked to the lack of accountability, as discussed, where no support structure was put in place or properly communicated in terms of support and maintenance for these solutions. It was unfortunate that no sustainability was found in terms of these solutions. It appears that most solutions adopted, focused only on short-term objectives, without linking to strategic long-term goals and the sustainability and continuity of these solutions was not possible. As a result, some healthcare professionals and local management fail to see the value of these solutions and continue to use their traditional methods of service delivery, even though they have proven to be inefficient considering the time and cost involved. This puts further strain on those appointed to foster the implementation of these solutions, as they cannot justify or motivate the value of using these solutions to colleagues, especially when there is limited information about their future. Although it was found that some solutions were functioning very well, some intended users were ignoring them, because they were unaware of the future of such solutions and the period of their existence. Hence, they had reservations about using them, fearing that they could be moved just when they get used to them. Thus, they continue to

work in traditional ways. Others lost interest owing to a lack of timely support in critical situations. The extracts from the interviews below highlight these responses:

"The department should consider drawing maintenance and sustainability plans earlier for these solutions" (Respondent 1: Case 4).

"What will happen with the solutions after the pilot phase? Who is going to support us? "(Respondent 2: Case 1).

"Strategies to transfer the ownership to the respective sectors should be stated and agreed to in early ages of these solutions" (Respondent 3: Case 2).

In addition to the questionnaires and the interviews, document analysis was conducted and the following findings were made.

5.3.1.3 Document analysis

From the documents analysed, such as business cases, proof of concept documents, project documents, policies and project meetings minutes, it was evident that quality management does exist in the organisation and, that at some level it has aspects that apply to project levels. However, there are no clear principles that enforce or ensure that the project conforms to a certain level of quality. The document analysis showed that a QA method in use is challenged by a lack of standardisation in terms of the processes used in solutions, as each solution may adopt any process seen fit. There is room for improvement in terms of clear accountability and a sustainability plan for the solutions. In addition, this includes the need for monitoring and evaluation, a knowledge base and continuous improvements.

5.3.1.4 Summary for sub-question 1

Generally, the respondents agreed that there was a general quality management strategy in place, and these strategies were developed in terms of a quality management system and

standards. However, the implementation of these strategies and their use on a project implementation level seems to only be prevalent in the vendors that supply the e-heath solutions (n = 3). On the other hand, the participants from the ECDoH (n = 6) were not as confident about the level of detail of the strategies and their applicability to the project implementation level in ensuring quality. This was further supported by the participants from the ECDoH who showed no awareness of any quality manual in place for projects to follow. Throughout the organisations there were common limitations: all participants revealed the non-existence of a "lessons leant" knowledge base, which is an integral part of QA and a key for improved quality and continuous improvement in organisations and projects.

Furthermore, the findings revealed that there needs to be improvements in the existing methods covering the areas of traceability, accountability, quality upfront, customer involvement, independent QA and the use of modern tools and techniques in e-health acquisition in the Eastern Cape. The findings of the second research sub-question are discussed next.

5.3.2 Second research sub-question

The purpose of this research sub-question is to investigate how the currently adopted methodologies aid project success.

How do these methodologies aid successful e-health acquisition in these rural hospitals?

The data collection methods used to answer this sub-question were the questionnaire, interviews, expert reviews and observation (*cf.* table 5–1). A detailed discussion of the findings is provided, starting with the results obtained from the questionnaire.

5.3.2.1 Questionnaire findings

The questionnaire was completed by nine participants (*cf* section 4.2.5). To answer this subquestion, the respondes obtained from the questionnaire, Section D –topic 11 (*cf* 4.2.5), which focused on the value added by the QA methodology in terms of project success were used. To elicit this information, participants were asked some questions, which were used to collectively answer this sub-question. This sub-section presents the findings based on the details of those questions relating to this sub-question, which gives an outline of overall feedback relating to the value-added by QA methodologies in e-health solutions acquisition projects (topic 11). These findings are discussed.

• Value of quality assurance

For every organisation there are several reasons for adopting quality methods and standards rather than merely conforming to industry standards. QA assists in tracking the progress of projects to ensure that the solution will be successfully completed within the given constraints (*cf* chapters 2 & 3). Furthermore, it helps the project team to identify possible risks earlier on and aids continuous improvement and knowledge management. From the results it was found that, even though the methodologies adopted have their shortcomings, they did play an integral role in making the project the success. Accordingly, in concurrence with the literature reviews (*cf* chapter 3), the study findings reveal that the use of QA methods aid successful implementation and help to eliminate risks. Participants agreed that QA methods add value, however, shortcomings were noted in existing methods. Most shortcomings relate to a lack of guidelines and that current methods and standards are formulated for the developed world and for generic systems development processes. Hence, it is important for this study to develop a model that caters for the shortcomings of existing models and provides guidelines in a manner that is appropriate for the context of this study, as these are not available in the current published body of knowledge.

Figure 5–3 below shows the findings regarding the second subquestion.



Figure 5-3: Questions on value added by QA

Figure 5–3 above shows the participants' knowledge of the role that QA plays within projects. These findings are further summarised in Table 5-4.

No.	Question	Findings summary
1	Did the quality assurance activities	All the participants acknowledged the positive impact of QA for project
	within the project assist the project	success. The findings show that 67% of the participants agreed with
	team in achieving the project's	this statement, while 33% of the participants strongly agreed that QA
	goals?	activities adopted have assisted in achieving project goals
2	Are there weaknesses in the quality	The participants indicated that there were existing shortcomings and
	assurance activities that you feel	weaknesses in the QA activities, which should be addressed to add
	should be addressed to add more	more value to future projects. As depicted in figure 5-4 above, 56% of
	value to future projects?	participants agreed with this item while 44% strongly agreed.
3	Was the system implementation	This question differed in terms of each solution; it was found that
	process adopted successful?	- Teledermatology and Teleradiology solutions were viewed as
		successful in all cases/hospitals (n = 5)
		- There were mixed results in terms of the success of Mindset and
		TeleECG/Spirometry, however, they were viewed as successful in
		most cases (n = 3)
		- Teleconsultation was regarded as having failed in all cases
		(n = 5)

Table 5-4: QA value-add summaries

		The overall scores are shown in the figure above and they indicate that 67% of participants agreed, while 33% of participants neither agreed nor disagreed owing to the mixed results stated above.
4	Do you feel that the system	All the participants perceive QA as being an integral part of project
	implementation process would have	success, as 78% disagreed and 22% strongly disagreed.
	been successful without the QA	
	activities?	

These findings reveal positive feedback on the value added by QA in e-health solutions and in project success. However, there is room for improvement because the participants indicated that there are weaknesses in QA activities.

Findings from the interviews are discussed in the next subsection.

5.3.2.2 Interview findings

To find out the users perceptions in this regard, several sub-questions, as shown in Table 5-5 were asked. The participants were probed with regard to the key elements of existing models or based on their experiences of QA that they view as being essential and that they believe are required. The purpose of this was to find out the existing gaps in current project models. The interview findings relating to this sub-question are summarised in Table 5-5 below:

	Research question	Research answers
1)	Do you see a need for QA methodologies?	Respondent 1: Yes. They support continuity and help ensure that all is well
		Respondent 2: Yes. They help ensure that we comply with the standards and produce quality products.
		Respondent 3: Yes, actually for all projects – there is higher need for QA methodologies or else the project is doomed!
		Respondent 4:

Table 5-5: Interview results for sub-question 2

Research question	Research answers
	Yes, how can you not assure quality?
	Respondent 5: Yes, though it may be cumbersome to squeeze in hectic projects.
 What QA activities do you think would add to the success of the projects? 	Respondent 1: Involvement of sites at easier stages of the project Respondent 2: There is higher need for senior management support,
	although this seems to be getting resolved. Respondent 3: There must be more time invested to awareness and training. Respondent 4:
	More solution testing, training and continuous feedback, as well as early involvement and awareness of the users.
	Feedback, awareness, evaluations, management reviews and reports, ongoing training and involvement of sites timely.
3) <i>Do you think that those</i> activities are part of the currently	Respondent 1: No. there's limited user involvement, awareness and a training strategy that works.
used QA methodology?	Respondent 2: Not really! User acceptance and ownership of solution is not achieved with the current methodology.
	Respondent 3: No. It does not cover fundamentals such as infrastructure and facilities, which eventually affects the quality.
	Respondent 4: To some extent yes, but new strategies for training and evaluations must be included.
	Respondent 5: Yes, there solutions are technically perfect, but the training needs attention.

Table 5-5 reveals that participants have a positive perception of the importance of QA for ehealth solutions and project success. However, certain improvements were suggested for helping the methods add more value on e-health solution implementation. These improvements include activities such as reviews, feedback, involvement, awareness, training and testing. The next subsection discusses the findings reached during the expert reviews relating to the second research sub-question.

5.3.2.3 Expert reviews

The experts acknowledged and emphasised QA as being an integral part of quality management, and stated that it has a great impact on project success. They believe that, although quality does not guarantee project success, it does provide essential elements to ensure that quality errors are identified and mitigated early on in the project. When asked about the value of QA methodologies in project success, the following comments were made:

"QA methodologies exist and have a greater impact on the project success, those that don't have them are doomed for failure" (Respondent 1).

"QA does not guarantee success, but having a QA methodology in place, helps ensure that steps to deliver a quality system are taken" (Respondent 2).

"QA methodology does not only support the project to success, but further provides standardisation which facilitates continuity and maintenance of solutions" (Responded 3).

"The value of QA methods is that it aids for sustainable projects, in addition to meeting customer expectations" (Respondent 4).

"QA methodology assists the project team to understand the steps that needs to be followed. This becomes even more of a case in e-health solutions where there are limited people who are clued of what needs to happen. So it provides guidelines and government of key activities that must be followed to meet quality Expectations" (Respondent 5).

5.3.2.4 Summary of sub-question 2

The findings discussed relating to the second sub-question reveal that greater value is added by adopting QA methodologies in projects. The findings collected using the various instruments reveal a consensus that, although QA does not guarantee project success, it does aid the project team in achieving its project objectives, evaluating progress and identifying risks, changes and actions to mitigate those risks identified earlier in the project lifecycle. The findings do, however, show that there are limitations in the current methodology and if these are addressed earlier on in the project lifecycle, greater value can be added throughout the project process.

The findings relating to the third research sub-question are discussed in the next subsection.

5.3.3 Third research sub-question

The purpose of this research sub-question was to elicit the challenges that are experienced when applying QA methodologies during an e-health solutions acquisition project.

What are the challenges experienced when applying these methodologies in rural hospitals?

The data collection methods used to answer this sub-question were the questionnaire, interviews, expert reviews and observations (*cf.* table 5-1). A detailed discussion of the responses to the third research sub-question is provided, starting with the results obtained from the questionnaire.

5.3.3.1 Questionnaire findings

As has been presented in the discussion on sub-question 1 (*cf* figures 5-1 & 5-2), the existing QA methodology experienced challenges with customer involvement, traceability, continuous improvement, independent QA, quality upfront, qualified staff, accountability,
and QA tools and techniques. Furthermore, it was found that there are some weaknesses in the existing methodology, which, if improved, can result in QA methodologies adding more value to project success. Figure 5-4 below depicts the participants' responses when asked if the existing QA methodology used in e-health solutions acquisition projects had any weaknesses.



Figure 5-4: Existing QA weaknesses

From figure 5-4 it is clear that the existing QA methodology is lacking in some of the aspects that are viewed to be crucial for QA, as 56% of participants agreed that their QA methodology has weaknesses, while 44% strongly agreed.

The interview findings relating to the third research sub-question are discussed in the next subsection.

5.3.3.2 Interview findings

During interviews the challenges faced relating to the QA methodology adopted were elicited, looking both at process level and at the quality-in-use point of view. Hence, the questions are those specific to the process level and to generic QA methods use. Table 5-6 indicates the answers in response to items relating to the third research subquestion.

Table 5-6: Interview	results for	sub-question 3
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Research question	Research answers
1) What are the generic	Respondent 1:
challenges that you are currently	The biggest problem is training, we train and people leave and that leaves us back to square one.
faced with during projects (not QA	Respondent 2: User training is the biggest problem; the current model is involving
specific)?	only one user for from each hospital and that particular person can die or leave and leaves none knowing about the solution.
	Respondent 3:
	about the solution use, support and maintenance, as well as channels is the biggest problem in these projects.
	Respondent 4:
	The general attitude and user buy in to the solution – some have been trained but they opt not to use the solutions.
	Respondent 5:
	Limited user involvement and training is the problem.
	Respondent 6:
	affects quality as it is not always sufficient to cater for these solutions.
2) What specific QA problems are	Respondent 1:
you currently experiencing?	I he lacking user involvement and user requirements leads to deployment of un-required solutions.
	Respondent 2:
	Poor user involvement, training and management reviews is the problem
	Respondent 3:
	There is challenge with evaluations and feedback of the solutions. No post-implementation evaluations
	Respondent 4:
	The sites do not take ownership and accountability of the solutions.
	Respondent 5:
	Limited QA activities in general is the problem, roles and responsibilities, communication, involvement, reviews, evaluations, testing and training.

Table 5-6 shows that there is a need for improvement in QA methodology and there are challenges with its use. The next subsection discusses the findings obtained from the expert reviews.

5.3.3.3 Expert reviews

The findings reveal that there are challenges in adopting and implementing QA methodologies in solution implementation projects. There seems to be a consensus from the expert reviews that the major challenges are due to human aspects other than the methodology itself. These are aspects that relate to issues such as acceptance, change, training and education, understanding, practicality and, finally, the implementation of these QA methodologies. Below are some comments that were made in the interviews:

"The challenge to implementation of QA methodologies, is the lacking understanding of their intent and benefits; which then results to resistance from the project team, especially is it changes their norm of doing things" (Respondent 1).

"People are resistant to change, especially when they don't know. The problem with these methodologies is the lack of knowledge to those who are to implement them" (Respondent 2).

"The challenge is education, knowledge, understanding, and implementation of these methodologies in organisations. As a results people are resistant to use them, as they don't know their intent, benefits, and they don't understand how they can implement them within their processes" (Respondent 3).

"The major barrier is the people, and the other one is to take the QA methodologies as they are, one needs to customise them to fit in the environment or they will never work" (Respondent 4).

"Missing involvement, training and communication to the team hinders the adoption of QA methods in projects" (Respondent 5).

5.3.3.4 Observation (anecdotal records)

The following anecdotal records show how the observations were documented and which are relevant to this sub-question.

Table 5-7:	Anecdotal	records	relating t	to sub-que	stion 3
			· • · • · • · · · · · · · · · · · · · ·		

Anecdotal Records			
Hospital: St. Patrick's Assessment Date: 18-Feb-2010. Observation period: 14:00–17:15. Observation comments: The site coordinator is very involved and enthusiastic about the solutions, and there were several awareness sessions that were held in this hospital. However, there seems to be problems with a lack of management involvement, which then affects the use of these as there is no enforcement in place. Furthermore, there is a lack of understanding of the maintenance and sustainability plan of the solution. They resist getting acquainted with something that may be taken away or may not work in the future.	Hospital: Settlers of Grahamstown Assessment Date: 28-Jan-2010. Observation period: 13:00–16:30. Observation comments: Due to limited involvement, the remaining staff is not sure of the solution and technophobia has been observed especially among the nursing staff. This affects quality of use. Poor training leads to ineffective use of solution. Although there was a site coordinator involved before, he passed away and a new coordinator was appointed with limited knowledge. Of the 5 solutions, only TeleECG and Teleradiology are used as a result.		
Hospital: Madzikane Assessment Date: 18-Feb-2010. Observation period: 07:00–12:20. Observation Comments: This hospital is hampered by several challenges; firstly, limited involvement, which hampers awareness and use. The major barrier for this was the infrastructure: since the solutions were deployed in 2006 they have never been used, except teleradiology, owing to network infrastructure failures. The power limitations are one of the problems, as a result, the Mindset solution was not in use at the time of my visit.	Hospital: Uitenhage Assessment Date: 28-Jan-2010 Observation period: 09:00–12:00. Observation comments: Although Teledermatology is successfully used in this case, the challenges with channels, accountability, support and maintenance are reasons that the solution is not used by other professionals. A poor attitude has developed to the teleradiology solution due to lack of technical support and assistance from the ECDoH on the problems experienced.		
use, the channels for its assistance and who should be contacted in an emergency.			

Therefore, the overall challenges and weakness of the methodology can be summarised as follows:

- Lack of accountability;

- Poor user involvement levels;
- Lack of monitoring and evaluation of solutions and their use
- Lack of training;
- Limited top management support and involvement;

- Unreliable infrastructure has led to ignorance of solutions;
- Lack of awareness of the solution intent has led to ineffective use or no use at all of the solutions;
- Lack of e-readiness assessment, which would have identified the barriers to implementation, such as requirements of infrastructure, facilities and relevant training.

5.3.3.5 Summary of sub-question 3

Although some of the challenges experienced result from other factors, an effective QA methodology would have helped to identify and mitigate possible risks earlier on in projects. All the data collection instruments used have highlighted the weaknesses in existing QA methodology, especially in the key principles such as quality upfront, user involvement, clear accountability, independent QA evaluations, the use of QA tools and techniques, qualified staff, traceability and continuous improvement. It is clear that most of these challenges are related to and are the results of the adopted QA methodology weaknesses. The following section summaries the findings relation to the first three sub-questions.

5.4 FINDINGS SUMMARY

This study presents and discusses the use of QA methodologies by organisations during the acquisition of e-health solutions in or for projects for rural hospitals in the Eastern Cape Province. The Table 5-8 outlines the key research findings relating to the QA principles discussed in this chapter.

QUALITY PRINCIPLE	SUMMARY OF RESULTS
Customer	The relationship between suppliers and the department was evaluated and
involvement/participation	showed at an acceptable level. However, there was a lack of involvement of the
	actual solution users. Thus, the relevant stakeholders should be identified and
	involved earlier in the project.
Quality upfront	The QA activities planned for upfront in the project were evaluated and it was
	found that there was insufficient quality applied upfront. Thus there is a need to

QUALITY PRINCIPLE	SUMMARY OF RESULTS
	plan quality activities upfront in the project through the use of key quality
	checkpoints and the implementation of project management plans.
Strong project management	Although there was no specific project manager, which is a danger to IT
discipline	projects, the project coordinators performed this role in addition to their own
	roles to their level best. However, some activities need more attention, such as
	changes to the quality planning, training, accountability, sustainability plan,
	stakeholder identification and involvement, controls through metric reports, and
	the use of plans.
Traceability	This area was found to be lacking and needed urgent attention. This could be
	achieved by making use of standardised document management, using a proper
	numbering scheme and version control, and formalising the deviations and/or
	decisions during the projects. Introduce formal change management processes.
Continuous improvement	It was also found that this area needed a lot more attention during projects. This
	process should be improved by making use of reviews, evaluations, lessons-
	learnt sessions, action item registers, quality compliance plans and root cause
	analyses.
Independent reviews	It was found that independent reviews are not performed during the projects.
	These types of review are important to ensure that the project is still on track
	and that unknown risks to the project are identified earlier, which will assist in
	delivering a successful project. The post-implementation reviews will also
	ensure the effective use of solutions.
Qualified staff	This was also found to be an area of concern. Care should be taken to ensure
	that knowledgeable people form part of the project team and that team members
	are fully aware of their responsibilities.
Clear accountability	The assigning of clear accountability during the project was evaluated and it was
	found that it needs attention, especially in terms of use, support and
	maintenance of the solution.
QA tools and techniques	It was found that these are not utilised. This area can be improved by making
	use of tools such as cost benefit analyses, process analyses, cause and effect
	diagrams, variance reports, random quality reviews, peer reviews,
	documentation reviews, and phase reviews.

In addition to the above findings, some of the challenges found to be common to the participating hospitals are the following:

- Lack of accountability;

- Poor user involvement levels;
- Lack of monitoring and evaluation of solutions and their use;
- Lack of training;
- Limited top management support and involvement;
- Unreliable infrastructure leading to ignorance of solutions;
- Lack of awareness of the solution intent leading to ineffective use or no use at all of solutions;
- Lack of e-readiness assessment to identify barriers such as infrastructure needs, facility needs and relevant training.

5.5 RECOMMENDATIONS IN TERMS OF THE FINDINGS

This study presents and discusses the QA methodologies adopted in e-health solution implementations, their success and the value they add, and their weaknesses. Based on the findings discussed in this chapter, the following recommendations can be made:

- The Eastern Cape Department of Health should focus on implementing and enforcing QA methodologies, which can ensure that the following QA activities are taken care of within the e-health solution acquisition projects:
 - User awareness and involvement;
 - Clear accountability;
 - Support and maintenance plan and structure;
 - o Sustainability plan;
 - Traceability;
 - o Continuous improvement of the QA process;
 - o Independent QA reviews throughout the project;
 - Monitoring and evaluation;
 - o Change and risk management;
 - Use of qualified staff;
 - Proper use of QA tools and techniques;
 - \circ Ongoing training .

An approach to inject QA into the existing processes should be devised to ensure quality. A starting point has been given in this study – using the GQAM (chapter 6), using the provided GQAM framework to aid implementations (chapter 7). The ECDoH should place more focus on the following aspects during projects in order to facilitate the successful implementation of e-health:

- At the beginning of the project, sufficiently skilled resources are identified and acquired where needed, to work on the project.
- User requirements and specifications are properly defined at the beginning of the project. This is achieved by identifying the respective needs of each hospital then selecting the relevant solutions to fulfil those unique needs. Although e-health solutions are mostly packaged applications, when needs are identified they can be customised to meet requirements of each specific hospital. E-readiness assessment can include tools that will assist to elicit the holistic needs from the solution to function.
- Users of the system are identified in each hospital and involved early in the project life cycle.
- Monitoring and evaluation metrics are planned and agreed on upfront and continuous management evaluation and reports to be done at each phase of the project.
- Post-implementation evaluations identify those solutions that are not effectively used and devise ways to mitigate the identified challenges.
- Facility and security are elicited prior to purchasing the solution, which will contribute to the ineffective use of certain solutions currently adopted.
- Scope changes throughout the project are limited to the absolute minimum and proper change management processes are followed to manage them and their risks.
- The level of testing performed by the users is broadened to ensure that all aspects of the system are viewed, implemented and tested before it is rolled out.
- The training provided to users should be divided into different levels to ensure that where users are computer illiterate, a basic computer literacy course is given before

training on the new system is undertaken; and this training is ongoing to enforce system use and encourage the users.

- Communication methods are implemented to ensure frequent communication between the project team and the suppliers, and between project team members. This includes the sites/hospitals to decrease miscommunication.
- Top management are involved in order to agree on sustainability plans, accountability, roles and the responsibility matrix, and resource availability.
- The involvement of other stakeholders, such as Internet Service Providers, is vital and important for the success of these solutions.
- There is involvement and collaboration between the service departments and the ehealth team to strengthen the awareness and understanding of the e-health solutions future and benefits.
- There is a central support centre within the department that gives users support relating to the use of the solutions. This should not only be in terms of technical support, but should provide advice on issues that may result from a lack of knowhow.

Table 5-9 outlines the key challenges for each hospital.

Findings			
	Hospital: Uitenhage		
Hospital: St. Patrick's	The use of Teledermatology has been successful in		
Teleradiology has made a great impact on service	this hospital. It has taken the initiatives in capitalising		
delivery in this hospital. Reduced patient transfer,	on the potentials of this solution to the extent that a		
which leads to reduced costs, has been noted. The	local dermatology clinic has been developed, which		
enthusiasm and dedication of the site coordinator is	relies on this solution. This has promoted		
one of the solutions implemented in this hospital. It is	collaboration among staff members and knowledge		
also important to acknowledge the efforts invested in	transfer has been observed.		
awareness and training for the solutions. Even			
though this is the case, some elements of a lack of	Although teleradiology was also implemented and		
detailed training were identified, as some aspects	greater user acceptance was achieved, it seems to be		
that the solution aims to eliminate were seen as	fading as the users of this solution have lost trust in		
failures, such a printing and films which are not to be	the solution and are reverting to their old ways of		
used when the solution is effectively used.	doing things. Resistance to the solution has been		
	observed owing to failures in the solution.		
However, much effort seemed to have been invested			
in teleradiology, and less consideration has been	The critical problems experienced with this tool are		
given to other solutions, which resulted in a poor	the anomalies experienced with the images and the		

Table 5-9: Summaries of the hospitals

attitude in other members who are to use those solutions such as TeleECG & TeleSpirometry, as they did not perceive their solutions as important and this thus led to limited or no use. Failure in terms of awareness and clear accountability has been seen mostly on Mindset and Teleconsultation, where Mindset for patients was sometimes off due to staff members not understanding its intent. On the other hand, Teleconsultation was never used in this hospital.	reports that it generates. The reports seem to contradict the images in most cases and this may lead to wrong diagnoses and can harm the patient. Several attempts have been made to resolve this matter with no success, but the feedback received was to some extent unprofessional and placed the blame to the users for their ineffectiveness and thus led to a negative attitude towards the solution.
Hospital: Madzikane It was disappointing to note that since my first visit to	Hospital: Settlers of Grahamstown Teledermatology was successfully used in this
the hospital in 2006, the same problems that were reported then still exist. Most of these problems relate	hospital, with potential for the future.
to the network infrastructure required to support	Though there were other solutions deployed, the new site coordinator was not yet informed about their
hospital but support and maintenance – especially	whereabouts and use as the previous coordinator has
the procurement process for repairs and	since passed away. So awareness and training was
reported since 2006 with no assistance. This is	solutions used, the limited number of staff members,
exacerbated by A negative attitude, a lack of trust in	especially the nursing staff, who were not aware or
the department and its willingness to assist resulting from a lack of response and assistance. Alack of	trained on the solutions which affects a number of aspects
training and awareness is another issue as the only	
doctor who was involved in these solutions has since	
left and the newly appointed coordinator cannot	
account for the solutions as they have never been	
used nor can they be used owing to a of support.	

Hospital: Settlers of Grahamstown

Teledermatology and Teleradiology were successfully used in this hospital with most potential for the future.

Though other solutions were deployed, the new site coordinator was not yet informed about the use and major challenges of these solutions, as the coordinator involved was on sick leave. However, training was already scheduled by the department to train some staff members on the use of these solutions.

Awareness and training was lacking in this hospital as was evident from the use of solutions and the limited number of staff members; the nursing staff in particular was not aware or trained to use the solutions which affects a number of aspects.

RECOMMENDATIONS

- 1. The focus seems to be on teleradiology and Teledermatology, leaving other solutions and their users feeling less important and resistant to those solutions. Thus awareness programmes on the importance and use of other solutions should be considered.
- 2. A lack of clear accountability and channels of support hinders the use of these solutions. For example, a doctor may require expert *advice* on an emergency case; however, when they get to the solutions firstly they don't know who to talk to for speedy assistance or to follow up on the sent case; or, even worse, the solution at that point is not working; which then jeopardises trust in the solution and eventually leads to non-use of the solutions as they do not add value when required. Therefore, clear accountability and a channel map should be drawn up for each solution for each hospital, to state who to talk to when technical advice is needed on a solution, as well as technical support and maintenance, healthcare-related expertise, emergency case contacts, feedback follow-ups and escalation channels.
- 3. Limited user involvement has led to a lack of awareness and use, and training has been done with

only one or two people who then left or have died. This then takes the department back to step one; therefore ongoing training for several staff members is needed, who will then in turn train others in the hospitals as required.

- 4. Sustainability and maintenance plans the hospital needs to be aware that it is the owner of the implemented solutions and it has to take responsibility for them at the end of the pilot period. This is even more critical as most hospital management is not aware of what should happen in the future with the solutions. The department therefore needs to collaborate and gain approval from all management, including those in services, to ensure that these solutions become the part of the tools used for healthcare provisioning.
- 5. Top management involvement can enforce the use of these solutions thus meaning that the benefits they promise can be reaped. However, there seems to be limited involvement from top level management in the Departmental offices through to the hospital levels. Management are only informed when the solution is to be implemented and once it is implemented they disappear.
- 6. E-readiness and e-awareness could assist in ascertaining requirements; although the hospitals face common challenges, their complexities and priorities differ based on their context and ways of doing things. Thus critical solutions can differ from hospital to hospital. As an example, in Uitenhage the Teledermatology solution used is compared with St. Patrick's owing to the demographics of the people they serve. This makes the solution less important in St. Patrick's; however, Teleradiology is becoming more of a priority. The department can save a lot of money if requirements are ascertained and readiness is achieved earlier to identify the unique needs for each hospital and devise mitigation steps for the identified challenges this may lead to solution customisation to meet the context of the hospitals.
- 7. Evaluation this element is not considered by the ECDoH, indeed most of the challenges identified could have been identified in the earlier stages of the projects, or at least within a few months of implementation. It seems that the temptation is to roll out as many solutions to as many hospitals as possible; understandably, this is due to the challenges faced by the healthcare sector. However, if this is driven from the requirement point of view for each hospital it would add great value to the province and the quality of care given to the communities. Thus e-readiness assessment and e-awareness can be used as tools to guide the requirement gathering.
- 8. Ongoing training strategies should be in place for each hospital. Several methods can be adopted, such as workshops, practice using the solutions, checklists of the solution use, and considerations to include the training on the key solutions on the curriculum of healthcare professional's qualifications.
- 9. IT effectiveness, IT infrastructure and support in these hospitals are below par. This is a major barrier for most developments in rural hospitals. A number of research studies have been conducted and failures reported, but nothing has been done yet. To have a central support centre for IT related matters, including these e-health solutions, could be of a great value in the success of hospitals and ICT projects in rural hospitals. This support centre should be equipped with technical experts for all solutions; their use should also guide the users in the most effective ways to use the solutions. A technical support technician should be made available to each hospital or at least within a region.
- 10. Collaboration and workshops among the hospitals should be introduced to promote knowledge sharing and support among staff members at the different hospitals for each solution. This can be achieved through video-conferencing, which could identify use for the unused The Teleconsultation solution has been implemented in all hospitals.

5.6 CONCLUSION

This chapter discusses the findings relating to the first three sub-questions of this study. The findings obtained from the data collection instruments, such as the interviews, questionnaires, observations, document analysis, expert reviews and literature study, reveal that there are QA methodologies for e-health solution acquisition in rural hospitals in the Eastern Cape

Province. It is important to note the critical support of these findings for literature relating to the importance of QA in solution design and implementation. The findings reveal the perceived critical role played by QA in ensuring project success. However, there are challenges and weaknesses in implementing QA methodologies.

It was clear that there was no standardised methodology for implementing e-health solutions in the selected hospitals. Although the contracted vendors adopted their own methodologies, these seemed to focus more on product development, thus the quality aspects were those that focused on solution functionality as per specifications. This highlights that project management and QA that ensure the generic quality from a project process perspective are installed in the project and was found to be lacking; hence, the challenges were experienced at the end, with some solutions.

It was evident that most problems that exist could have been identified and resolved earlier if QA had been adopted in the process of acquiring these solutions. However, there was no defined process for the solutions to follow, so each solution followed its own different methodology which led to several challenges:

- Traceability, accountability, sustainability, support and maintenance;
- Stakeholder awareness and involvement;
- Compliance and standardisation;
- Requirement analysis and readiness assessment;
- Quality upfront, continuous improvement, independent QA, evaluation and knowledge base;
- Qualified staff and training;
- QA tools and techniques.

Within this chapter recommendations to the ECDoH were made, of which one of the proposed remedy is the consideration of the Generic Quality Assurance Model (GQAM) for e-health solutions acquisition for rural hospitals in the Eastern Cape Province. The next chapter presents the findings regarding the fourth research sub-question, which will result in the development of GQAM.

6 THE GENERIC QUALITY ASSURANCE MODEL (GQAM)

6.1 INTRODUCTION

In the previous chapter, the research findings relating to the first three sub-questions were discussed. These findings revealed that existing QA methodologies are being used in e-health solution acquisition projects and those methodologies do add value and ensure success in projects. From the findings, it was clear that there was no standardised methodology for implementing e-health solutions in the selected hospitals. Although the contracted vendors adopted their own methodologies, these seemed to focus more on product development, the quality aspects adhered to, were those that focused on solution functionality as per specifications only. This highlights the fact that QA as a subset of project quality management, which ensures the generic quality from a project process perspective, was found to be lacking. There were challenges experienced with some solutions.

It was evident that most of the problems that existed were those that could have been identified and resolved earlier if QA had been adopted in the process of acquiring these solutions, in addition to the generic ICT projects implementation barriers experienced by developing countries (*cf* chapter 2). However, there was no defined process for the solutions to follow, so each solution followed its own different methodology which led to several challenges, including:

- Traceability, accountability, sustainability, support and maintenance;
- Stakeholder awareness and involvement;
- Compliance and standardisation;
- Requirement analysis and readiness assessment;
- Quality upfront, continuous improvement, independent QA, evaluation and knowledge base;
- Qualified staff and training;
- QA tools and techniques.

In this chapter the responses to the fourth research question are presented followed by the proposed Generic Quality Assurance Model (GQAM) for aiding the success of, and ensuring, e-health solutions acquisition for rural hospitals in the Eastern Cape Province. This model was developed on the basis of the research findings and through the adopted model development cycles over time.

6.2 A SENSIBLE MODEL FOR E-HEALTH SOLUTIONS

6.2.1 Fourth research sub-question

The purpose of this research sub-question was to elicit the key components of a sensible QA model to avoid the challenges faced as stated in the above sub-questions.

What sensible model can be adopted to overcome these challenges and to improve the quality assurance processes used in e-health acquisitions in rural hospitals?

The data collection methods used to answer this sub-question were the expert reviews and the literature study (*cf.* Table 5-1). A detailed discussion of the responses to the fourth research sub-question is provided, starting with the results obtained from the literature review.

6.2.1.1 Literature study

As found in literature review in chapter 3, there are several models, methods and standards relating to QA. The literature reveals that, in order to have an impact on project success, there is a need for standardised methodologies. It is evident that QA activities include several elements that have some form of review, inspection, approval and testing; which are an integral part of the methodology for solution implementation (Standish Group, 2001; ISO, 2007; Schwalbe; 2007; Avison & Fitzgerald, 2006: 568; Maciaszek, 2007: 6; SAQA, 2007; Ruxwana *et al.*, 2010).

The list below includes, of importance, the factors that contribute to the success of IT projects that a sensible QA model needs to consider, as described in the Standish Group study (2001):

- Executive support
- User involvement
- Experienced project manager
- Clear business objective
- Minimised scope
- Standard software infrastructure
- From basic requirement
- Formal methodology
- Reliable estimates
- Other criteria, such as milestones, proper planning, competent staff, and ownership

Looking at the above it is clear that most, if not all, of these factors can be controlled and better managed if QA is continuously applied and planned for within a project. Indeed, the existing standards and models do not provide context-relevant guidelines on quality, but a generic view of quality management. Hence, it is important, when considering the different complexities of rural areas in South Africa, to have a model that is relevant to the context and developed within the culture.

6.2.1.2 Expert reviews

In addition to the literature study, it was important to collect primary data on the important issues and key factors relating to QA in solution development within the e-health sector in South Africa. Although the data gathered were not directly linked to rural hospitals and projects, it was important to consider those factors that are critical for any model that is aimed at introducing QA in solution development projects. The experts were asked to reflect on their experiences and to give their perceptions of the challenges inherent in implementing existing quality methods, standards and models in South African organisations, in relation to Project Quality Management. In addition, the experts were asked about the elements of the most

sensible model required to overcome the QA challenges in solution implementation for rural areas. From all the experts' reviews, it was evident that it is important for businesses to have standardised processes for delivering solutions to enable solution traceability and further support sustainability. The experts all pointed to people as being the main barrier to the adoption of methods and standards. The reasons for this relate to aspects such as education, knowledge, skills, applicability and implementability, and resistance to change.

The findings of the expert reviews relating to the most sensible model that can be adopted to overcome the challenges faced with QA when implementing solutions are summarised below.

"The challenge to implementation of QA methodologies is the lacking understanding of their intent and benefits; which then results to resistance from the project team, especially if it changes their norm of doing things. Therefore the elements of the most sensible model include awareness and change preparation for those who are involved" (Respondent 1).

"The problem with QA methodologies is the lack of knowledge to those who are to implement them; thus proper guidelines which clearly states the accountability, roles and responsibilities and acceptable standards becomes key for QA methodology" (Respondent 2).

"The challenge is education, knowledge, understanding, and implementation of these methodologies in organisations. As a results people are resistant to use them, as they don't know their intent, benefits, and they don't understand how they can implement them within their processes" (Respondent 3).

"For any methodology to be sensible, it needs to fit in to the context of its use; thus it must meet the different needs of its users" (Respondent 4).

"QA is about continuous involvement, thus evaluations, knowledgebase and continuous involvement, training and evaluation becomes critical for success of such models" (Respondent 5).

"The most sensible model for QA is the one that enforce standardisation of the project activities to a certain degree; with the aim to support continuity and maintenance of such solution" (Respondent 6).

Although most of these comments concur with the literature findings , what was interesting was that stakeholder participation and involvement were unanimously cited as the most effective way to overcome the challenges, with an emphasis on user awareness and involvement. There was consensus about that models or methods that are customised to fit a certain environment can enforce standards and quality in solution design processes, and these models or methods should be used in a way that fits the culture of the environment and are successful when driven by its users. This is in line with the purpose of the study, that is, to develop a locally relevant QA model, the GQAM, to establish quality and improve success in e-health acquisitions in rural hospitals.

6.2.1.3 Summary of sub-question 4

The findings reveal that the most sensible QA model is one that puts the solution's stakeholders first, defines quality from their perspective and develops a means to ensure that the specified expectations are met. From these findings the key elements of such a model should be:

- User awareness and involvement
- Training and support
- Standardisation
- Clear accountability through roles and responsibility and stakeholder maps
- Promoting and enforcing the management of a knowledge base
- Traceability of expectations through continuous reviews
- Relevant and customised to fit the environment in which it is used

- Providing support for meeting technical and human expectations
- Facilitating continuous improvement

Propositions for a model that is sensible for overcoming the challenges identified and discussed in this study are examined in the following sections.

6.2.2 Proposed sensible QA model

According to Arsham (2006), a model is an external and explicit representation of a part of reality as an individual sees it, who wishes to use the model to understand, change, manage and control that part of reality. Arsham (2006) further states that the purpose of a model is to aid in designing a solution and to assist in understanding a problem.

The purpose of this study was to develop a Generic Quality Assurance Model (GQAM) for the successful acquisition (i.e. development and implementation) of e-health solutions in rural hospitals in the Eastern Cape Province for improved quality of care and service delivery. In order to develop and test this model it was necessary to identify the QA methodologies that are currently used in rural hospitals for e-health solutions acquisition (sub-question 1); to further evaluate the adopted QA methodologies to determine if they were the most sensible methodologies for successful acquisition and to determine their role in ensuring the acquisition success, their shortcomings and adoption challenges in system acquisition (sub-questions 2-4). These have been answered in the respective sub-questions discussed in the previous chapter (cf chapter 5 for sub-questions 1–3) and the above sections of this chapter (cf 6.2.1 for sub-question 4).

In order to develop such a model in a manner that is relevant and fits the context of its implementation, a user involvement approach was adopted where the e-health team and other relevant stakeholders were involved (as discussed in 4.3). To further ensure that the model was within the general practice and can fit any typical Solution Development Life Cycle (SDLC), experts' reviews were considered. This representative involvement was adopted in a series of cycles to formulate the model elements, designs and testing (*cf* section 4.2.5.3). As

stated in chapter 4, the study process happened through the four phases followed (*cf* section 4.2.5). The first two phases (phases 1 & 2) focused on case studies where the data were collected to answer the research questions using data triangulation to provide findings and conclusions. The findings obtained from the case studies were used in phase 3 to develop the first draft of the QA model in layers. The layers continued through to phase 4 where the draft QA model developed from the case study findings evolved until the final generic QA model (GQAM) was produced. In phase 4, the GQAM was used as input to the cycles for developing a QA value chain (presented in chapter 8), which provides the implementation guidelines for the GQAM.

The next section presents the proposed generic QA model (GQAM) for e-health acquisition in rural areas. This model aims to mitigate the challenges experienced in this process.

6.3 GQAM FOR E-HEALTH SOLUTIONS

6.3.1 Purpose of GQAM

The purpose of GQAM is to aid the successful acquisition, the development and implementation, of e-health solutions for rural hospitals in the Eastern Cape Province. This can be achieved by using the GQAM as a blueprint for the fundamental elements and project quality management processes that need to be followed to ensure that quality will be met in the end, irrespective of who is implementing the solution. This model is referred to as "generic" because it can be used for any e-health solution acquisition project, for any adopted systems development method, and for any given context for ensuring quality within project management processes.

This study asserts that, since e-health solutions are acquired for enhanced healthcare and are mostly adopted for safety and mission-critical activities, to ensure that these solutions are of high quality and that the processes used to develop and implement them follow the best QA methodologies and standards, by emphasising QA in project management, is pivotal.

In order to ensure the quality of the processes used to implement e-health solutions in rural areas, this section presents the proposed GQAM for e-health solutions acquisition within the Department of Health for rural hospitals in South Africa, developed on the basis of these study findings.

As has been stated, QA means 'the sum of activities that assure the quality of products and services at the time of production or delivery' (South African Qualifications Authority (SAQA) 2001:6). According to Kerzner (2006:846), QA is the collective term for the formal activities and managerial processes that attempt to ensure that products and services meet the required quality level. It includes efforts external to these processes that provide information for improving the internal processes. Thus, QA is essential for e-health to reach its full potential, as it is concerned with the consistency, readability, usability, maintainability, reliability and other attributes of the completed system and the work products produced throughout the project life cycle (Nabrzyski, 2002). Quality is assured through multiple review points with the customer to identify errors, inconsistencies, misunderstandings and omissions in each interim work product (Nabrzyski, 2002). According to Townsend (1997: 113), QA is the process by which the quality improvement process itself is confirmed and it assures that optimal outcomes are reached.

As QA involves periodically evaluating overall project performance to ensure that the project will satisfy the relevant quality standards, it is taking responsibility for quality throughout the project life cycle (Foster, 2007: 24; Schwalbe 2007: 307–314). Therefore, by adopting models and standards that enforce activities to ensure the ongoing quality of e-health solutions, the failure rate can be reduced. If a GQAM is appropriately adopted as a project quality management method, it will help to identify and resolve issues promptly that may undermine the quality of e-health solutions in the later stages. This becomes crucial for solutions developed in rural areas, where technical and technological expertise is scarce, and limited resources do not allow for failure or wastage.

6.3.2 GQAM layers

This model encompasses several layers and each layer or stage comprises functions or processes to be executed that have different interlinking deliverables. Figure 6-1 shows the proposed layers for this model:

- 1. Identification of stakeholders and users;
- 2. User needs and expectations;
- 3. Method selection;
- 4. Quality management;
- 5. Continuous improvement QA.

Figure 6.1 below presents a synopsis of the GQAM, showing the layers named above without the details on the processes in each layer.



Figure 6-1: GQAM synopsis

As discussed in chapter 4, section 4.2.5, the model layers were developed in cycles starting with the first layer through to the final layer. Considering the continuing failure of IT projects,

this model development was motivated by the literature findings (*cf* chapters 2 & 3) and the findings of this study, which showed the importance of QA method adoption in project acquisition for successful implementation and continuous improvement. From these findings, it was evident that most of the factors in project failure are related to project management. However, the existing literature focuses on the project implementation in the developed world. Although there is limited literature on project implementation in South Africa, there is none that covers aspects of project quality management in e-health projects or of IT project implementation in rural areas. Even the work that has been done in e-health solutions international sphere does not cover aspects of QA in solution acquisitions.

However, the existing literature provides the fundamentals that were required to develop the model in that it gives the key principles and elements of QA, as a subset of project quality management, obtained from the quality standards, methods and models (chapter 3). Furthermore, the literature study revealed the common barriers and artefacts that lead to the failure of IT projects worldwide, including those that have been implemented in rural areas of South Africa (chapter 2). As stated, these findings together with the primary findings obtained from this study, were use to develop the model in layers. Table 6-1 summarises the layer development, linking each layer to the most important data source:

Layer	Description	Data source
	Identification of each project stakeholder and	Reflection on lessons learnt on the implemented
	understanding their different roles and influence in	solutions (chapter 2); the project management body
Layer 1	the project and its success becomes critical. Key	of knowledge (PMBOK) and project quality
	to this is identification of the solution users and	management (chapter 3); study findings (chapter 5-
	catering for their different needs	6)
	This layer focused on issues relating to user	Literature discussion on the theories of quality; ISO
Layer 2	involvement, user needs and expectations as the	standards; TQM – the quality principles (chapter 3);
	drivers of quality.	discussion on challenges on ICT implementation in
		rural South Africa (chapters 2 & 5).
Layer 3	This is about considering the existing	Study findings (chapters 5–6); the discussions on
	organisational methods, principles and standards	methodologies, standards and models (chapter 3).

Table 6-1: Method layer summary

	for projects. This includes adoption or adaptation	
	of methods and principles.	
Layer 4	This layer fosters QA as a subset of project quality	Project quality management literature, TQM and
	management	PMBOK (chapter 3); findings (chapters 5–6)
Layer 5	This layer recognises QA as an integral part of	The PDCA methods; CMMI and Six Sigma (chapter
	continuous improvement in project processes,	3). This need was clearly identified in the results of
	activities, knowledge base, deliverables and	this study (chapter 5-6).
	methods.	

Figure 6-27 presents the comprehensive GQAM with details of the key processes for each layer.



Figure 6-2: GQAM for e-health acquisition in rural healthcare

This model was built from the inside out, with users forming the central point of departure, with other stakeholders being considered through to the outer layer of continuous improvement of the processes adopted inside and the implementation of the model. These layers are discussed below, starting with layer 1.

LAYER 1: STAKEHOLDER AND USER IDENTIFICATION

In this layer, the model acknowledges the importance of project stakeholders and solution users.

First, project stakeholders are identified. This can be achieved by an impact analysis to identify those involved, and those who may be affected by the project or the outcomes of the project. In the case of e-health solutions, stakeholders may include, but are not limited to, those shown in Figure 6-3:



E-health Stakeholder Representation

Figure 6-3: e-health solution stakeholders

From the identified stakeholders, the potential users of the solution are elicited and a user list is generated. Once the user list has been created, the user involvement plans should be developed and agreed on. These should include the roles the users will play in the project phases and the modes of communication and feedback.

As stated in ISO 9004:2000, every organisation has interested parties, each party having needs and expectations. Interested parties of organisations include:

- Customers and end-users;
- People in the organisation;
- Owners/investors (e.g. Shareholders, individuals or groups, including the public sector, with a specific interest in the organisation);
- Suppliers and partners;
- Society, that is, the community and the public affected by the organisation or its products.

Therefore, an integral part of this model is to identify project stakeholders and solution users; however, their involvement in the project implementation phases is even more critical, using the appropriate involvement level, at each stage of the project lifecycle. At this stage the stakeholder map and user list should be produced together with the project roles and responsibilities.

LAYER 2: USER NEEDS AND EXPECTATIONS (Quality Defined)

This layer advocates quality definition based on user expectations.

Firstly, user needs and expectation have to be ascertained, analysed and specifically documented. Appropriate user representative and involvement levels should be adopted, and their commitment to these requirements should be achieved by means of specification sign-offs. As needs and expectations change, user involvement throughout the project cycle will

assist in decision making on quality impact and the mitigation steps resulting from the changing user needs and expectations.

According to ISO 9004:2000, the success of the organisation depends on understanding and satisfying the current and future needs and expectations of present and potential customers and end-users and understanding and considering those of other interested parties.

From these study findings it is clear that, to understand and meet the needs and expectations of interested parties, an organisation should firstly :

- Identify its interested parties and maintain a balanced response to their needs and expectations;
- Translate identified needs and expectations into requirements;
- Communicate the requirements throughout the organisation;
- Focus on process improvement to ensure value for the identified interested parties.

Once the needs and expectations have been understood and defined, quality from the user's point of view can be defined. In this layer, the meaning of a quality solution based on users' expectations can be defined and understood. Examples of customer and end-user needs and expectations, as related to quality, may include aspects like (*cf* 3.4.1):

- Conformity
- Dependability
- Accountability
- Functionality
- Availability
- Post-realisation activities
- Product safety
- Product liability
- Environmental impact

It is important to consider the solution needs, and the expectations of intended users, in the earlier phases of a project cycle.

LAYER 3: METHODS, STANDARDS, PRINCIPLES SELECTION

Once the needs have been defined and acceptable quality levels specified, the project team can select the methods that will be used in delivering the solution. There are several methodologies, models and frameworks for delivering a solution.

The key principles and standards should be selected for evaluating and measuring quality by ensuring that the requirements that have been defined are met. These should range from a project management perspective to a systems development perspective: firstly, the guiding principles of the organisation's quality management system and solutions acquisitions must be understood, to recognise the standards and their effects on the solution to be acquired, and adopt the methods, tools and techniques that are appropriate for ensuring that a quality solution is delivered to meet and exceed customer needs and expectations. The systems development lifecycle (SDLC), coupled with the basic project management phases, provides the most fundamental method for solutions acquisition projects.

This supports standardisation, clear accountability, aid for independent QA and continuous improvements. For example, activities such as document standards and template selection, entry and exit criteria, change management policies, communication principles, methods of development, testing, and so forth.

It is important to understand the guiding principles, methods and standards and to adapt them to fit the needs of the project with the aim to deliver a quality product that meets both the specified requirements and the users' expectations.

LAYER 4: PROJECT QUALITY MANAGEMENT

Quality management is the process of ensuring that all project activities necessary to design, plan and implement a project are effective and efficient with respect to the purpose of the objective and its performance (PM4DEV, 2008). Project quality management is not a separate, independent process that occurs at the end of an activity to measure the level of quality of the output neither is it the purchasing of he most expensive material or services available on the market (PM4DEV, 2008). Project quality management addresses the management of the project and the product of the project. It applies to all projects, regardless of their nature . Product quality measures and techniques are specific to the type of product produced by the project. For example, quality management of software products uses different approaches and measures to those used when building a nuclear power plant. However, project quality management approaches apply to both.

In either case, failure to meet product or project quality requirements can have serious negative consequences for any or all of the project stakeholders. Project quality management includes three processes: the quality plan, the QA, and the quality control, which are discussed:



This is the process of identifying quality requirements and/or standards for the project and product, and documenting how the project will demonstrate compliance. Quality planning should be performed in parallel with the other project planning processes. For example, proposed changes in the product to meet identified quality standards may require cost or schedule adjustments and a detailed risk analysis of the impact on plans. It has the following outputs:

- Quality management plan. This describes how the project team will implement the
 organisation's quality policy. It provides input to the overall project management plan
 and includes quality control, QA and continuous process improvement approaches for
 the project. This plan should be reviewed early in the project to ensure that decisions
 are based on accurate information.
- Quality metrics. A metric is an operational definition that describes, in very specific terms, a project or product attribute and how the quality control process measures it. A measurement is an actual value. Quality metrics are used in the QA and quality control processes.
- Quality checklists. These are used to verify that a set of required steps has been performed. Quality checklists are used in the quality control process.
- Process improvement plan. This details the steps for analysing processes to identify activities that enhance their value.
- Project document updates. These include documents such as, but not limited to, stakeholder maps, and roles and responsibilities matrices.



It is the process of auditing the quality requirements and the results from quality control measurements, to ensure that appropriate quality standards, and operational definitions are used. These further provide an umbrella for continuous process improvement (*cf* layer 5). This has the following outputs:

- Organisational process assets update. Elements such as quality standards may be updated.
- Change requests. These are created and used as input to change management processes to allow full consideration of the recommended improvements. They can be used to take corrective or preventative action or to perform defect repair.
- Project management plan updates. Updates may be made but are not limited to quality management plans, schedule management plans or cost management plans, etc.

 Project document updates. Project documents such as quality audit reports, training plans, process documentation, and lessons learnt etc, may be updated.



Quality control is the process of monitoring and recording the results of executing the quality plan activities to assess performance and recommend any changes needed. It is performed throughout the project. The quality standards include both the project processes and product goals. The quality control activities identify causes of poor process or product quality and recommend and/or take action to eliminate them. The following are the typical outputs of this process (Foster, 2007: 24; Schwalbe, 2007: 307–314; PMBOK, 2004):

- Quality control measurements. These are the documented results of quality control activities in the format specified during quality planning.
- Validated changes. Any changed or repaired items are inspected and will be either accepted or rejected before notification of the decision is provided. Rework may be required for those items that are rejected.
- Validated deliverables. A goal of quality control is to determine the correctness of deliverables. The results of the execution quality control processes are validated deliverables.
- Organisation process assets updates: Elements such as completed checklists, lessons learnt documentation etc, may be updated.
- Change requests. These are created for the defined change management processes to cater for recommended corrective or preventive actions or a defect repair that requires a change to the project management plan.
- Project management plan updates. Elements of the project management plan such as the quality management plan, process improvement plan etc, may be updated.
- Project document updates. Project documents such as quality standards and principles may be updated.

As seen above, these project quality management processes interact with each other and with the processes in the other domains, such as change management, configuration management, and so forth. Each of these processes occurs at least once in every project and occurs in one or more project phases, if the project is divided into phases. Although the processes are presented here as discrete elements with well-defined interfaces, in practice they may overlap and interact in ways not detailed here (PMBOK, 2004). This is one of the reasons why the other quality management processes are discussed, even though this study focuses on QA.

Thus, for e-health solutions, project quality management becomes key to aiding and overcoming the challenges stated in the findings of this study (*cf.* chapter 5), especially where activities and deliverables such as project plans, quality plans, metrics reports, change requests and change management, and lessons learnt updates are vital.

LAYER 5: CONTINUOUS IMPROVEMENT

According to PMBOK (2004), quality improvement includes taking action to increase the effectiveness and/or efficiency of the policies, processes and procedures of the performing organisation. QA provides an umbrella for continuous process improvement, which is an iterative means for improving the quality of all processes. Continuous process improvement reduces waste and eliminates activities that do not add value. This allows processes to operate at increased levels of efficiency and effectiveness.

The plan–do–check–act (PDCA) cycle, as depicted in the model, is the basis for quality improvement as defined by Shewhart and modified by Deming (PM4DEV, 2008). According to PM4DEV (2008), it is the most popular tool used to determine QA. PDCA can be briefly described as follows (ISO 9001:2008):

- Plan: establish the objectives and processes necessary to deliver results in accordance with customer requirements and the organisation's policies.
- *Do:* implement the processes.

- Check: monitor and measure processes and product against policies, objectives and requirements for the product and report the results.
- Act: take actions to continually improve process performance.

In addition, quality improvement initiatives undertaken by the performing organisation, such as TQM and Six Sigma, should improve the quality of the project's management and the quality of the project's product. Process improvement models include Organisational Project Management Maturity Model (OPM3®), Capability Maturity Model (CMM®), and Capability Maturity Model Integrated (CMMI), as discussed in chapter 3. As stated in ISO, the organisation shall continually improve the effectiveness of the quality management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventive actions and management review (ISO 9001:2008).

From the above layers, it is clear that the GQAM encompasses the elements that are essential for ensuring quality and, as a result, assist the successful acquisition of e-health solutions in rural areas. However, the models provide a high-level framework. In in order for such models to be understood and implemented, they need to be adapted to the existing methodologies, which provide some guidelines for greater detail of the model or framework implementations within the specific organization. This study found that the key elements that should be included in such a methodology in addition to the layers include the following elements:

- 1. *Management commitment.* Management shall provide evidence of its commitment to the development and implementation of e-health solutions projects and the development of quality systems in the organisation.
- **2.** *Responsibility and authority.* Responsibilities and authority should be defined and communicated in the project.
- **3.** *Management representative.* A management representative should be appointed and given authority by top management to manage, monitor, evaluate and coordinate the project quality.
- 4. *Management reviews.* To determine whether the processes are followed correctly.
- 5. Involvement of people. All stakeholders must be involved throughout the project cycle.

- **6.** *Awareness and training.* Users must be trained and other stakeholders must be aware of the solution and its intent.
- **7.** *Suppliers and partnerships.* Management should establish relationships with suppliers and partners to promote and facilitate communication with the aim of mutually improving the effectiveness and efficiency of processes that create value.
- **8.** *Documentation.* Appropriate documentation templates to be developed and controlled.
- **9.** *Security.* Solutions must be secure and confidential; both physical and information security to be considered.
- **10.** *Change management.* Throughout the project, changes must be managed and documented appropriately to avoid re-work and to create a knowledge base.
- **11.** *Traceability.* Requirement and quality traceability must be maintained.
- **12.** *Sustainability.* This must be developed together with other project plans, maintenance, support and others.
- 13. Monitoring and measurement
 - Customer satisfaction: monitor information relating to customer perception as to whether the solution has met customer requirements. The methods for obtaining and using this information shall be determined by the project team in cooperation with the customers/solution users.
 - Internal audit: conduct internal audits at planned intervals to determine whether the quality management system conforms to the planned arrangements and is effectively implemented and maintained.
 - Monitoring and measurement of processes: monitoring and, where applicable, measuring the quality management processes.
 - Monitoring and measurement of product: monitor and measure the characteristics of the product to verify that product requirements have been met.

Since solutions designs are complex and unique, a value chain which provides the GQAM implementation guidelines is presented in the next chapter (chapter 7) within the typical SDLC. The next section concludes the chapter.

6.4 CONCLUSION

This chapter presents the findings of the fourth research sub-question, in which user involvement, traceability, clear accountability, standardisation, continuous improvement and relevance are seen as elements for the most sensible model for QA in solution acquisition.

This chapter further presents a proposed GQAM for the successful acquisition of e-health solutions for rural hospitals in the Eastern Cape Province. This model was developed through a series of model development cycles, where the relevant stakeholders were involved, not only to gain their buy-in, but for them to incorporate elements that are locally relevant to their specific and unique needs and challenges in the rural areas of the Eastern Cape Province. The involvement of the stakeholders further promotes the adoption of this model as it instils a sense of ownership in the stakeholders.

This model does not guarantee project success – no single model can do that – however, it does provide guidelines for assuring quality and hence project success. This model focuses on project success and caters for the solution project management and the management of activities after its implementation. Thus, it promotes sustainability, and ensures that availability, maintainability and continuous improvements can be facilitated to improve services. This model proposes a first point for every project in assuring quality, identifying stakeholders and solution users, eliciting the needs of those users and their quality expectations. Finally, the methods, standards and principles can be considered. Thereafter, quality management activities and the continuous improvement of processes should be maintained to enhance services and improve maturity of processes.

This chapter describes some further elements that are vital to the solution cycle, which can aid the successful implementation of this model in adding value to solutions implementation in rural areas. Given the context of this research in under-resourced rural areas, guidelines to aid GQAM implementations are essential. As a result a framework for GQAM implementations is developed and is presented in the next chapter.

7 GQAM: A FRAMEWORK FOR IMPLEMENTATION

7.1 INTRODUCTION

As discussed in chapter 6, the GQAM proposed for successful e-health acquisition in rural areas is composed of five layers and was developed through the inspection of the existing standards and methods for quality, such as the ISO standards, PCDA, Six-Sigma, CMMI and PMBOK (2004). The model proposes five layers that will ensure that quality is installed and maintaining the continuous improvement of processes. The layers of the model are summarised below:

- Identify the stakeholders of the solution, and identify the actual users. Select the appropriate level and approach for user involvement. This is done to ensure that all project stakeholders are involved and the designs are driven by the users' perspective.
- When users have been identified, identify and specify user requirements for the solution. Identify users' quality expectations based on their needs. As quality is negotiable, quality for the project can be negotiated and defined on the basis of the user expectations.
- 3. Identify and adopt the appropriate methods, standards and principles relevant to the project. This includes activities such as template selection, activities and deliverables, project methods or phases, entrance and exit criteria, communication media, and suchlike. This will assist in governing the quality assurance process.
- 4. Plan and execute project quality management: including, quality plan, quality control, and QA.
- Improve processes on an ongoing basis, since QA also forms part of quality improvement, to improve the services provided by the existing process. This is the last layer of the model.

Although the description of the model makes it sound simple, implementation can require more detail and more guidelines, especially in the field of ICT, where several methods are available. Thus, a framework for implementing the GQAM has been developed to provide guidelines for the activities and deliverables within the process that will ensure compliance with the GQAM and, ultimately, quality and project success. This framework highlights the GQAM implementation in a typical SDLC. This chapterprovides background for the development of this framework and a discussion of the framework, and concludes by summarising its applicability and value.

7.2 BACKGROUND

The ISO promotes the adoption of a process approach when developing, implementing and improving the effectiveness and efficiency of a quality management system to enhance the satisfaction of interested parties by meeting their requirements (ISO 9004:2000). The ISO assert that for an organisation to function effectively and efficiently, it has to identify and manage numerous linked activities. An activity using resources and managed to enable the transformation of inputs into outputs is considered a process. Often the output from one process directly forms the input to the next. The ISO maintains that the application of a system of processes, can be referred to as the "process approach" (ISO 9004:2000). According to the ISO, the advantage of the process approach is the ongoing control that it provides over the linkage between the individual processes within the system of processes and their combination and interaction (ISO 9004:2000).

When used within a quality management system, such an approach emphasises the importance of (ISO 9004:2000):

- Understanding and fulfilling the requirements;
- The need to consider processes in terms of added value;
- Obtaining the results of process performance and effectiveness;
- Continual improvement of processes based on objective measurement.

The model of a process-based quality management system shown in Figure 7-1 illustrates the process linkages. In this illustration, it is evident that the interested parties play a significant
role in defining requirements as inputs. Monitoring the satisfaction of interested parties requires the evaluation of information relating to the perception of interested parties as to whether the organisation has met their requirements.



Figure 7-1: Process-based quality management system model Source: ISO 9004:2000

This process-based approach was taken into consideration when developing the GQAM proposed by this study and it is further elaborated on by the framework, which highlights the processes to be undertaken to adopt the GQAM in the traditional SDLC.

In order to develop the framework in a manner that is relevant and fits the context of its implementation, a user involvement approach was adopted. The e-health team and other relevant stakeholders were involved and the purposive representation levels of involvement were used. To further ensure that the model was within general practice and can fit any

typical SDLC, experts' reviews were considered. This involvement was adopted in a series of model development cycles to formulate the framework elements, design and testing (*cf* figure 6.2.2). Within these series of cycles, document reviews, interviews and group discussions were used to ensure that the framework, firstly, represents the model and ensures the applicability of such a model (*cf* 6.2.2.1, figures 6-2:6 & table 6-1). The participants involved in the review cycles of this framework included the e-health team, senior management, the project manager and coordinators, user's representatives, the IT directorate, vendors and suppliers, and various experts from the industry field of quality management, project management, senior management, solution design, business analysis, solution QA, and experts in the academic field of quality. This framework, which is the decomposition of GQAM into SDLC to show its applicability, is discussed next.

7.3 THE QA FRAMEWORK FOR E-HEALTH

According to Schwalbe (2007: 60), another problem in organisations contributing to project failure is not having standards or guidelines to follow that could help in project management. These standards and guidelines might be as simple as providing standard forms or templates for common project documents, or guidelines on how the project manager should provide status information to top management. Top management must support the development of these standards and guidelines and encourage or even enforce their use.

The ISO standard does not enforce or specify a process for any organisation to use in delivering their product or service. However, it does provide models of what must be accomplished, not how activities must be performed. For example, to qualify for ISO certification, an organisation must state what it does, do what it has stated and demonstrate what it has done. A litmus test for an ISO-certified organisation is that it should be able to make a quality product or provide a quality service even if its entire workforce were replaced (Maciaszek, 2007: 6). Thus, an organisation must design its own process for doing things, with the guidance of existing standards and models.

Standards are meant to guide and provide a standardised way of doing things. The lack thereof results in several solutions being implemented in different ways and different methods and principles used to produce them. Thus, lacking continuity and traceability in a solution affects the solutions sustainability. Having a QA framework, stating the value chain and methods that will result in standardised processes will help deal with the challenges and facilitate solution continuity (Ruxwana *et al.*, 2010). Such QA framework will help to define quality processes and standards that will assure quality in the resulting products. As stated by Kerzner (2006:72), achieving project management excellence, or maturity, is more likely with a repetitive process that can be used on each and every project. This repetitive process is referred to as a methodology, which in this study is presented in a framework.

According to Avison and Fitzgerald (2006: 568), a methodology is a recommended means to achieve the development, or part of the development, of information systems based on a set of rationales and an underlying philosophy that supports, justifies and makes coherent such a recommendation for a particular context. The recommended means usually include the identification of phases, procedures, tasks, rules, techniques, guidelines, documentation and tools. They can include recommendations about the management and organisation of the approach and the identification and training of the participants (Avison & Fitzgerald, 2006: 568). The three categories that motivate for a methodology, which this chapter aims to achieve within a QA framework, include the following (Avison & Fitzgerald, 2006: 568) :

- Better end product. The end product of the development process, tan information system, is improved. This is not the quality of the development process, which is discussed below.
- Better development process. This is achieved by tight control of development processes and identifying the outputs (or deliverables) of each stage. The results are improved management and project control. Productivity is enhanced with the use of a methodology and the use of a methodology reduces the level of skills required for the analysis, which improves the development process by reducing its costs. For some, the problems of developing information systems can be improved by adopting the quality standards that have proved popular in manufacturing and industry processes.

These standards are designed to enhance the quality of the processes rather than that of the end product. Another problem argued by Avison *et al.* (1994) is that the traditional manufacturing process is quite different from the process of developing software products. In concurrence, Pressman (2005) asserts that software is developed rather than manufactured. There are schemes that recognise these difficulties and attempt to interpret the standards and methods applicable to software development. Although such standards have not yet made a great impact, either in terms of coverage or improved quality, they are helping to raise the issues and levels of debate concerning quality in the development of information systems.

 Standardised process. These are the benefits of having common approaches throughout an organisation. This means more integrated systems can result, that staff can easily change from one project without retraining being necessary, and that a base of common experience and knowledge can be achieved. This includes easier maintenance of systems. According to Maciaszek (2007: 4), supportability (adaptiveness) is defined by a set of three system features – understandably, maintainability and scalability.

According to Avison *et al.* (2006:572), "a methodology can range from being designed to be applicable to specific types of problems in certain types of environments or industry to an all-encompassing general-purpose methodology". In this study, the methodology, presented in a framework, is specific to GQAM implementation in e-health projects in rural healthcare centres in the Eastern Cape Province. This framework can be applied or adapted to other environments or industries with similar problems or needs.

7.3.1 Process

A methodology describes how things should be done and different organisations often have different ways of doing things (Schwalbe, 2007: 80). Within a methodology there are different processes executed. A process is a series of actions directed towards a particular result (Schwalbe, 2007: 80).

According to Maciaszek (2007: 6), a software process defines the activities and organisational procedures used in software production and maintenance. The process aims to manage and improve collaboration in the development and maintenance team so that a quality product is delivered to the customers and it is properly supported afterwards. He further promotes that organisations should define or customise their own process models to fit the organisation's needs (Maciaszek, 2007: 6).

Therefore, a process is a logical sequence of tasks performed to achieve an objective and a way of decomposing a large task into smaller subtasks. Process defines what is to be done, while methods are used to specify how tasks should be completed, and the tools can be used to enable or automate a method for completing a process. This means, therefore, that the GQAM gives the bigger process of what is to be done, while the method defined in this chapter proposes ways on how that model process can be achieved in e-health solution acquisition in rural areas.

There are several ways in which the processes within a methodology can be presented. This chapter uses a value-chain framework.

7.3.2 Value chain

Dekker (2003) defines a value chain as a horizontal linked set of value-creating activities from basic raw material sources for component suppliers to the ultimate end-use product delivered into the hands of the customer. He further states that the focus in value chains is downstream, mainly on the benefits that accrue to customers, the interdependent processes that generate value and the resulting demand and funds flows that are created (Dekker, 2003).

A value chain refers to a sequence of productive (i.e. value-added) activities leading into a series of value-generating activities referred to as the value chain. A generic value chain model comprising a sequence of activities found to be common to a wide range of firms was introduced by Michael Porter in his 1985 book on completive advantage (Porter, 1985).

A value chain is a chain of activities adopted in an organisation to fulfil a specified result, product or service. Products pass through all activities of the chain and at each activity the product gains some value. The chain of activities gives the products more added value than the sum of added values of all activities (Porter, 1996).

Therefore, a value chain framework was adopted to categorise the generic value-adding activities for implementing the GQAM for e-health solutions within the traditional Solution development life cycle (SDLC) depicted on the following page. It was developed by applying the SDLC mainly because it forms the basis of any solution acquisition methodology. Moreover, e-health solutions consists of ICT applications and hardware, as a result they follow similar processes as any IT solution. Thus, the use of SDLC would enhance the understanding and implementation of GQAM within the traditionally accepted method. Furthermore, though the GQAM is based within the project quality management domain, it is essential to understand that, despite the fact that project management is mainly accountable for quality in project, ensuring that project quality is maintained is the responsibility of all project members and stakeholders. The principles advocated by the GQAM cut across different domains and expertise involved in a project, hence using the typical SDLC than the project management lifecycle, would not centre its implementation solely on the project management domain.



Figure 7-2: GQAM: Framework for Implementation

The framework, as depicted in Figure 7-2, begins with a strategic recommendation or change request for an e-health solution to respond to an identified business need. Once approved, the eight consecutive phases of the process begin. The phases depicted in Figure 7-2, with their respective QA activities and deliverables ,and the relative GQAM layers, are presented in the table below.

Initiation phase	QA project activities	QA deliverables		
This provides guidelines to identify the work required before a project commences.	 Concept workshop RFP/RFB decision QA principles review Review project schedule Register business case Lessons learnt session Award scope of work Implement quality –management strategy Assign delegation of authority Analysis of QA function Project QA review session Documentation review Phase reviews RFP/RFB decisions 	 Requirements model (draft) Feasibility study Quality management strategy Document review process Stakeholder map Roles & responsibility policy System doc checklist Quality manual Responsibility matrix Project doc templates QA principles checklist Phase sign-off 		
Applicable GQAM Layers: All layers (1-5)				
Planning phase	QA project activities	QA deliverables		
This describes the planning and high level design by devising and maintaining a workable scheme to accomplish the business need that the project is to address.	 Award bid Quality audit Deliverables review Review detailed scope Review test strategy Documentation review Update statement of work Project QA review session Review project schedule Conduct start-up workshop First executive walk-through Lessons learnt session Neg. acceptance criteria Assign roles & responsibilities Phase review 	 Start-up workshop Entrance/exit criteria Risk management plan QA principles checklist Lessons learnt doc Requirement traceability- matrix (RTM) Business case (approved) Change management plan Detailed scope Service level agreement (SLA) Project management plan QA plan PM checklist Roll-out strategy Config. man plan Test strategy Training strategy Quality metrics report 		

Table 7-1: GQAM Framework for implementation value chain phase's description

		 Quality audit report Compliance checklist Phase sign-off 		
Applicable GQAM Layers: 2 & 4				
Design phase	QA project activities	QA deliverables		
This describes the solution baseline by producing a documented solution specification that will satisfy the requirements.	 Quality audit Lessons learnt session Review project schedule Review design documents Review roll-out plan Management walk through Project QA review session Documentation review Deliverables review Phase review 	 Requirements model (final) Compliance checklist (update) Communication plan Final design docs Implementation plan Lessons learnt doc (update) Training specification Quality metrics report Quality audit report Training plan Roll-out plan User list Phase sign-off 		
	Applicable GQAM Layers: 1, 2, 3, 4 &	5		
Development phase	QA project activities	QA deliverables		
This provides the actual solution construction based on the design specification baseline.	 Code reviews Review test plan Quality audit Deliverables review Documentation review Project QA review session Acquire infrastructure Test solution software (unit testing) Build/customise solution Install hardware Resolve conversion fallout Create support structure Lessons learnt alertness session Phase review 	 Continuity plans Solution manuals PM checklist (update) Compliance checklist (update) Lessons learnt doc (update) Support structure plan Test plan & test cases Compliance checklist (update) Quality metrics report Quality audit report Phase sign-off 		
Applicable GQAM Layers: 2, 3 & 4				
Verification phase	QA project activities	QA deliverables		
This consists of the testing and appraisal of solution baseline and support needs.	 Quality audit Lessons learnt Perform system User acceptance testing Review test results Management walk through Verify software of solution Project QA review session Documentation review Deliverables review Phase review 	 Lessons learnt doc (update) Management reports System docs checklist Test books & results Compliance checklist (update) Quality metrics report Quality audit report Phase sign-off 		

Applicable GQAM Layers: 1, 4 & 5				
Pilot phase	QA project activities	QA deliverables		
This provides the real-time verification and monitoring of exported results.	 Train users Quality audit Lessons learnt Perform solution pilot Resolve fallouts Documentation review Deliverables review Phase review 	 Exception report Lessons learnt doc - (update) Quality metrics report Pilot impact analysis Compliance checklist (update) Quality audit report Phase sign-off 		
Applicable GQAM Layers: 1, 2, 3, 4 & 5				
Roll-out phase	QA project activities	QA deliverables		
This establishes the solution in production environment according to solution specification and its configuration baseline	 Lessons learnt Implement solution roll-out plan Deliverables review Phase review 	 Exception report Compliance checklist - (update) Lessons learnt doc –(update) Phase sign-off 		
Applicable GQAM Layers: 4 & 5				
Hand-over phase	QA project activities	QA Deliverables		
This phase is the end of the solution project; it involves gathering information for process improvement and formal transfer of responsibility to the production environment.	 Final quality audit Man. walk through Post implementation evaluation Review QA process for- improvement Independent audit on -project Documentation review Phase review 	 Lessons learnt doc - (final) Acceptance certificate Independent audit report PM checklist (final) Compliance checklist – (final) Quality management – strategy (update) Quality audit report Project sign-off 		
Applicable GQAM Layers: 1, 4 & 5				

It is important to note that this framework proposes the QA activities and deliverables that should be considered in the different phases adopted in implementing e-health solutions. As projects have different requirements and timelines, quality needs will differ. The activities and deliverables illustrated in this framework are not fixed and can be negotiated with the project stakeholders to identify the ones that are applicable or any additional ones required.

It is important to note that the phases can be combined to include fewer phases in a project with combined activities. It is possible to shift certain activities between project phases. the framework illustrates a typical process that can be implemented for adopting the GQAM in e-health projects for rural communities.

7.4 CONCLUSION

This chapter presents a process approach, showing the framework of the GQAM for e-health solutions that is implementable and easier to understand. It is easier for the stakeholders to adopt a quality model using a process that injects quality activities into the existing processes.

In this study, the GQAM is shown within the SDLC and has been broken down into activities and deliverables for each phase. Having this in place does not guarantee project success but will assist the success of such projects and will further ensure the continuity of the solution, because it provides documentation and guidelines for solution development, and certain deliverables that must be met during each phase to ensure the quality of the solution.

It provides some standardisation of processes, which promotes sustainability. With the emphasis on documentation, the training and knowledge base are built and the solution continuity and support are promoted for future, in addition to the maintenance and accountability. The next chapter summarises and concludes the study.

8 SUMMARY, REFLECTIONS AND CONCLUSIONS

8.1 INTRODUCTION

This study describes the phenomenological research philosophy supported by the social constructivism approach that was followed in designing a GQAM for e-health acquisition in rural hospitals in the Eastern Cape Province, and subsequently, it proposes QA value chain implementation guidelines.

This study was motivated by both the researcher's interest in healthcare and based on personal experience on poor healthcare in rural areas. The study was triggered by the rapid ICT innovations and developments within the health informatics, known as "e-health". Considering the challenges faced by rural hospitals, it was interesting to note the considerable potentials these e-health solutions have, especially in cost reductions, mitigation for skills shortages and poor service delivery.

An initial study was conducted in 2006-2007 for a Masters Degree dissertation, where technology assessment in rural hospitals was conducted. The main purpose of that research was to verify the existence, use and effectiveness of e-health solutions in rural areas in the Eastern Cape Province. From that study, implementations of e-health solutions were found to be failing mainly because of several challenges, such as those mentioned in chapter one of this thesis.

However, most of the identified challenges causing the e-health solution failures were those relating to the lack of quality assurance as a subset of project quality management. This observation was striking, considering the fact that quality is a non compromise item in healthcare, and that quality has gained momentum in several organizations as a critical factor for any project success. Despite the existence of several methods, standards, and models globally to aid quality within solution implementation projects, e-health solution acquisition for rural hospitals in the Eastern Cape Province were failing due aspects relating to the lack of quality. A question worth investigation became whether the adoption of quality assurance

models can add value and ensure success of e-health solutions acquisition, especially within a rural context.

This thesis is such a research initiative. This research is, however, of the opinion that a locally relevant model that enforces the quality standards and methods is essential to aid the quality assurance in e-health solution acquisitions in rural areas. This notion was inspired by several scholars, such as Heeks (2002), Schwalbe (2007), and others, because there is not a single solution, methodology, framework, model, or standard produced from the developed world that can be applied as is within the context of the developing world. Considering the different challenges and complexities unique to the rural areas, a specific model to foster quality assurance becomes essential. Therefore, the main purpose of this study was to develop a Generic Quality Assurance Model (GQAM) for the successful acquisition (i.e. development and implementation) of e-health solutions in rural hospitals in the Eastern Cape Province for improved quality of care and service delivery. However, it is critical to ensure that such model caters for the complexities of the rural context. This led to the research question:

What are the components of a generic quality assurance model (GQAM) to assist rural hospitals in the Eastern Cape Province with the successful acquisition of ehealth solutions?

A clear understanding of the essential elements for a quality assurance model that can work in a rural context would make such a model more worthwhile for those who are involved in the process of e-health solution acquisition and to further enable the understanding of the required and expected quality standards that must be met for such a project to succeed.

This chapter presents discussions on the answering of the research questions, the study contributions to the existing body of knowledge, the research presentation adopted, the study limitations and the suggested further research options. This chapter provides conclusions of this thesis.

8.2 REVIEW OF RESEARCH STUDY IN ANSWERING THE RESEARCH QUESTION

Based on the previous knowledge and experience in the research field, this study was planned and executed in four phases, with various participants from various hospitals. These formed the cases, which interlink to answer the research questions and to develop the GQAM and its framework for implementation.

In-depth literature reviews were conducted in the first phase on both ICT developments and on Quality" motions, methods, models and standards to create the basis for the study (cf chapter 2 and chapter 3). As part of this phase a total of 29 participants were selected from 5 different hospitals, to form 5 case studies; in addition 6 independent experts were selected for expert reviews (cf chapter 4). In the second phase, data was collected. Based on the knowledge gained previously, enough times and appointments were made, with room for exceptions for the participants due to the limited resources in rural areas. Even though there were some appointments that had to be rescheduled due to emergencies and unavailability of participants, this has not negatively impacted the study as such instances were proactively planned for. This study did not have issues of non-participation.

As it has been stated in chapter one, sub-questions were used to elicit data that will aid to answer the main research question. In order to determine the components of and to develop this model, it was necessary to identify the QA methodologies that are currently used in rural hospitals for e-health solution acquisition. This was necessary to further evaluate the adopted QA methodologies to determine if they are the most sensible methodologies for successful acquisition and to determine their role in ensuring the acquisition success, their shortcomings and adoption challenges in system acquisition. As a result, the sub-questions were used to elicit data about those objectives. Care was taken to ensure that the different complexities that differentiate the context of rural areas from urban and the developed world, were considered to inform the development of a general quality assurance model (GQAM) that can foster QA in e-health acquisition projects in rural areas.

Although different instruments were used to collect data, care was taken to ensure that those were administered to relevant participants to aid collection of reliable data. The questionnaires, which were more managerial, were administered to the 9 participants, while the interviews were conducted with all the participants. Although the study applied semistructured interviews, some questions had to be translated in the language that some participants would understand especially for the technical terms and their language had to be used, such as isiXhosa.

A detailed account of the study findings is presented in chapter 5, while findings specific to the elements essential to the model are given in chapter 6. Within the findings of this study, it is evident that the lack of quality assurance is the key contributor for solution failures, and this is due to challenges faced in the implementations of the adopted QA methodologies. Challenges such as the lack of accountability, poor user involvement levels, lack of monitoring and evaluation of solutions and their use, lack of training, limited top management support and involvement, unreliable infrastructure has led to ignorance of solutions. The lack of awareness of the solution intent has led to the ineffective use or no use at all of the solutions, and the lack of e-readiness assessment, which can assist in the identification of the barriers to implementation, such as requirements of infrastructure, facilities and relevant training.

Data obtained form these findings, in addition to secondary sources, the essential components for a model to foster quality in rural context were identified. These informed the development of a Quality Assurance Model in its draft version in phase 3. Through a series of reviews and development cycles within the phase, the model evolved from different versions until the final Generic Quality Assurance Model (GQAM) in phase 4 emerged.

This GQAM was well accepted as one of the first stepping stone for developments aiming to promote better healthcare in the Eastern Cape Province. However, a concern was its implementation, considering the fact of shortages of skills and expertise in the field and the different levels of literacy and diversity of to the involved stakeholders. As a result, a GQAM framework for implementation was developed, to provide guidelines on GQAM

implementation using a typical SDLC, presenting the value chain of activities and deliverables that should be achieved to ensure that quality is met and to aid the successful acquisition of e-health solutions.

8.3 CONTRIBUTION MADE BY THIS RESEARCH STUDY

This research study contributes to the existing body of knowledge on two levels, the theoretical and the practical level.

8.3.1 Theoretical Contribution

This research adds value by the contribution it makes to the existing body of knowledge in the fields of Information Systems/Technology, Health-Informatics, Quality Assurance, and Project Quality Management (as shown in Appendix E, presenting a list of publications in these different domains).

In the current literature, there is limited information available on the evaluation of e-health solutions implemented in rural contexts and none on issues relating to QA as a subset of project quality management. Although project quality management has been noted internationally as being one of the key factors in IT project success, there is limited focus on QA as an integral part of project success and none related to the context of e-health implementation globally.

8.3.2 Practical Contribution

This study determined the essential components that are critical for a quality assurance model that can effectively aid successful e-health solution acquisition in rural areas. Considering the various complexities that differentiate the context of the rural areas from that of the urban and developed world, a model (GQAM) to foster QA in e-health acquisition projects in rural areas was developed. The GQAM aids the adoption of quality standards in e-health projects in rural areas and provides ways to overcome the challenges relating to

project management identified during the study. In addition, it helps to ensure the successful implementation of e-health solutions and facilitating and promoting continuous improvements within the project process and after project implementation, through project evaluation and knowledge-base creation.

Furthermore, this study provides a GQAM framework for implementation, which provides the value chain implementation guidelines for the GQAM within the typical traditional SDLC. These guidelines encompass the activities and deliverables that have to be considered to ensure that QA is not compromised within and after the project lifecycle within the SDLC.

8.4 RESEARCH PRESENTATION

The first chapter, Chapter 1, introduce the research, whilst Chapters 2 and 3 were devoted to the literature reviews. Chapters 4 discusses the adopted research methodology and underpinning philosophies, which is followed by Chapters 5 and 6 in which the research findings were discussed and the GQAM was presented respectively. The GQAM framework for implementation was presented in Chapter 7. In this final chapter, Chapter 8, the study reflection and conclusions are provided.

8.5 LIMITATIONS OF THE STUDY

The following are the limitations of this study (as was already highlighted in Chapter 1, section 1.7):

- The model was not tested in an operational setting.
- The model reviews only included specific experts in South Africa, specifically only those specialising in e-health solutions, project management and QA.

The first limitation of this study is that the developed model has not yet been put into applicability in an actual solution acquisition to ensure its validity and to identify areas of improvement or the actual value that it adds to aid successful e-health acquisition in rural areas. This is due to the complexities of the healthcare sector, the issues of ethics and the fact that e-health projects are highly confidential projects in which the researcher could not be involved in as an outsider. Furthermore, the e-health solutions planned for the 4 year period and all the projects have already been initiated, and as a result there was no available project in its initiation stages in which this model could be tested and verified. Though there were several projects already in progress, the limitation on this model application, was that the central and the key layers of this model are to be executed in the initial stages of the projects, thus applying the model in an already progressing projects would not only affect the model validations but would confuse the project team if there had to be changes in methodologies and processes.

Even though testing the model in a practical team would strengthen its validity, the model was verified for applicability, by several experts in the field of Project management, quality assurance, and e-health solution developments. This becomes a second limitation of this study because only those associated with these subject areas and the domains in which this model operates were used to review the applicability and appropriateness of the model. As quality means different things to different individuals, so does its management processes in different field of expertise. Thus, QA may significantly be defined the same way across domains but its implications and interpretations are different on their implementation context, hence, only those specific to the field were used to ensure that the model does not loose its focus which is the applicability to e-health solution acquisitions in a rural context.

8.6 FURTHER RESEARCH

Further research could be undertaken to explore the following:

Firstly, a study to validate the real value of QA models in solution acquisitions is required. This can be achieved by using the GQAM and its relative framework for implementation that were both developed by the researcher and which can be tested during e-health solution acquisition in rural hospitals in the Eastern Cape Province. To further test the "generic" value of the model, whereby the same GQAM and its framework are applied in an e-health solution

acquisition in another rural context other than the Eastern Cape Province. Moreover, the model's value and its validity can be further tested when it is applied in any systems implementation project at any organisation to determine the degree to which this model contributes to the success of the project and its areas for improvement.

Another aspect that can be explored is an evaluation of quality in use for e-health solutions, which could be undertaken to determine the actual value or loss of the implemented solutions in rural areas. This will link to the last layer (continuous improvement) of the GQAM to elicit the elements required to ensure continuous effective use of solutions and the ways to continuously improve the value of such a solution to the context of the applications.

8.7 CONCLUSION

This chapter reflected the value of this research study. It presented an overview of the study background and motivation, the discussion on the success of this research in answering the research questions, indicated the study contributions and the limitations. Finally, the uncovered options for further research were outlined.

The purpose of this study was to develop a generic Quality Assurance model (GQAM) for the successful acquisition (i.e. development and implementation) of e-health solutions in rural hospitals in the Eastern Cape Province for improved quality of care and service delivery. In order to develop and test this model, it was necessary to identify the QA methodologies that are currently used in rural hospitals for e-health solution acquisition to further evaluate the QA methodologies adopted and to determine whether they are the most sensible methodologies for successful acquisition. In addition, to determine their role in ensuring acquisition success, their shortcomings and the adoption challenges in system acquisition were outlined.

The findings of this study show that there are QA methodologies which are used, although there is no formalisation or standardisation of the processes of applying these methodologies. It was found that, although this is the case, the QA methods had a great impact on project success. These methods were found to have several weaknesses which if considered could add more value when corrected. This study has developed the GQAM which can be used to ensure e-health solution success in rural hospitals by overcoming the challenges and further introducing standards that will support sustainability and future maintenance of these solutions, while facilitating user buy-in and ownership through increased user involvement levels. To aid the implementation of this model, the QA value chain implementation guidelines were developed, as a GQAM framework for implementation, to inject the model in typical SDLC phases.

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10 APPENDIX A: THE STUDY QUESTIONNAIRE

	Nelson Mandela Metropolitan University	fela ⁿ Study questionnaire						
	SECTION A							
		Biographic I	nformation					
The Project	Solution Name:							
			Project Siz	e:	Project Sta	tus:		
Hospital/healthcare centre for which this solution will be deployed (and location):			Duration > 2 years	Duration <2 years	Completed	In progress	Closed	
Your role/position in this project (manager, project manager, business):			Experience Role (years/mor	e in this nths):	Your total e	experience	(years):	
	SECTION B							
-	Conorol Quality related	Information	VEQ				KNOW	
1.1	Does a Quality Management within your organisation?	System exist	TES					
1.2	Does a Quality Management which addresses the strategy during system implementation projects?	Strategy exist, to be followed n/development						
1.3	Has this Quality Managemen compiled taking into account standards, such as ISO 9000 PRINCE2 and CobiT?	t Strategy been quality assurance : 2000, PMBOK,						
1.4	Is there an adopted Quality M indicates the quality activities during a system implementat project?	lanual, which to be followed ion/development						

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15	Do the activities stated as part of the quality assurance function's responsibility address the key quality principles?					
1.6	Is there a Quality Forum responsible for quality approvals and evaluations?					
1.7	Is there a database or store for lessons learnt for projects?					
	SECTI					
	Questions relating to t	he Quality Pr	inciples			
2	Principle 1: Customer Involvement/Partnership	Strongly Agree	Agree	Neither agree Nor disagree	Disagree	Strongly Disagree
	Do business/end-users contribute in project					
0.1	meetings in terms of decision making, problem		0	0		
2.1	Solving and planning?	1	2	3	4	5
	agreed upon as part of supplier					
2.2	(internal/external) negotiations?	1	2	3	4	5
2.3	Were all these documentation deliverables agreed to by business (the organisation) as well as the project team at the beginning of the project?	1	2	3	4	5
24	Was there any start-up workshop held for this project, which involved business, end-users and project team members and were all expected outcomes of the project discussed and agrood to?	1	2	3	1	5
2.5	Was there any Responsibility Assignment Matrix completed for the project to indicate the responsibility of business, end-users, IT and the project team?	1	2	3	4	5
	Did all the project documentation have a stakeholder list, stating all the parties to whom		0			
2.0	Does documentation review tracking sheet, which provides the business users and other project stakeholders to sign-off the information, compiled and included all the		2	3	4	5
2.7	project documents?	1	2	3	4	5
2.8	Did a formal documentation review process exist which was either physically signed off or electronically approved?	1	2	3	4	5
3	Principle 2: Quality Up-front	Strongly Agree	Agree	Neither agree Nor disagree	Disagree	Strongly Disagree
3.1	Was a Project Management Plan drawn-up for the project?	1	2	3	4	5
3.2	Was this Project Management Plan approved by all relevant stakeholders?	1	2	3	4	5

3.3	Was there a Quality Plan developed for this project	1	2	3	4	5
3.4	Was this Quality Plan communicated, and approved by all project stakeholders?	1	2	3	4	5
3.5	Were all processes and procedures followed as determined in the quality plan?	1	2	3	4	5
3.6	Did the Quality Assurance Plan address the Quality Approach to the project?	1	2	3	4	5
3.7	Did the Quality Assurance Plan address the Project Metrics which described the type of metrics that will be collected and used to estimate, track, and control the project?	1	2	3	4	5
	Did the Quality Assurance Plan address the Quality Gates, which describes the quality objectives that will enable the project to measure the quality of the project at multiple					F
3.8	points in the project lifecycle?	1	2	3	4	5
3.9	upfront and documented?	1	2	3	4	5
4	Principle 3: Strong Project Management Discipline	Strongly Agree	Agree	Neither agree Nor disagree	Disagree	Strongly Disagree
4 1	was a project document compiled, based on a system implementation/development methodology stating all the phases of the project and the documentation that needs to be compiled during the project?	1	2	3	4	5
4.2	Were issues, risks and jeopardise managed according to their different procedures?	1	2	3	4	5
4.3	Was there a provision made for documentation reviews/approvals in the project schedule?	1	2	3	4	5
4.4	Was reporting on the overall project schedule done to allow resource allocation to areas deviating from the baseline plans (<i>Schedule</i> <i>deviation reports</i>)?	1	2	3	4	5
4.5	Was quality on the project controlled by monitoring the project results to determine if	4	0	c		L
4.0	Was corrective action taken to eliminate causes of unsatisfactory performance according to the quality reviews (Quality		2	3	4	3
4.6	reports)? Was project quality assured by making use of	1	2	3	4	5
4.7	Metric reports and measures of progress charts?	1	2	3	4	5
4.8	Were project quality assurance start-up workshops held to explain the importance of quality during projects to business, end-users and project team members?	1	2	3	4	5
5	Principle 4: Traceability	Strongly Agree	Agree	Neither agree Nor disagree	Disagree	Strongly Disagree

	5.1	Were changes to the budget properly controlled (<i>Cost deviation reports</i>)?	1	2	3	4	5
	5.2	Was formal deviations compiled and registered, documented and reported on to allow traceability (<i>Project Change Requests</i>)?	1	2	3	4	5
	5.3	When changes occur on the project, are roles and responsibilities updated accordingly and/or incorporated into the schedule according to the actions and deliverables responsible for?	1	2	3	4	5
	5.4	Was there minutes of this workshop compiled, stating the areas discussed, agreements reached and a list of the workshop attendees (in the form of a signed attendance register)?	1	2	3	4	5
	5.5	Was a proper document numbering scheme and version control process implemented for project documentation?	1	2	3	4	5
	5.6	Was the Quality Assurance team made aware of all the deviations/decisions that was registered for the project?	1	2	3	4	5
	5.7	Were risks/issues proactively identified and managed on the project according to procedures ?	1	2	3	4	5
	5.8	Were Entrance& Exit criteria compiled for each phase and approved before the project can move to the next phase?	1	2	3	4	5
	5.9	registered for the project, approved by the project's stakeholders?	1	2	3	4	5
	6	Principle 5: Continuous Improvement	Strongly Agree	Agree	Neither agree Nor disagree	Disagree	Strongly Disagree
6.1		Were there regularly review and update the Quality Plan?	1	2	3	4	5
6.2		Were specific Tools & Techniques (Process and Procedures) (i.e. templates, checklists, workshops lessons learnt) used to assist with continuous Quality improvement?	1	2	3	4	5
6.3		Was a Lessons Learnt Session held after each of the following (if applicable to the project):	1	2	3	4	5
	6.3.1	At the closure of a jeopardy?	1	2	3	4	5
	6.3.2	At the end of all key project milestones (KPMs)?	1	2	3	4	5
	3.3.4	At the end of the project?	1	2	3	4	5
6.4		was an Action Item register compiled for the project, stating actions to be taken after these sessions?	1	2	3	4	5
1			1	1	1	1	

6.6		Were periodic Result Reviews conducted with a Quality Forum or the Quality Assurance section to assess progress on current goals and where continuous quality improvement opportunities were identified?	1	2	3	4	5
6.7		Was these Besult Beviews documented?	1	2	3	4	5
•		Was Boot Cause Analysis Besults drawn-up					•
6.8		during the project?	1	2	3	4	5
6.9		Was a Risk Management Plan drawn-up for the project?	1	2	3	4	5
	7	Principle 6: Independent Quality Assurance	Strongly Agree	Agree	Neither agree Nor disagree	Disagree	Strongly Disagree
7.1		Were independent Quality Assurance reviews conducted on the project?	1	2	3	4	5
72		Were the results of these reviews taken into account during the project, to make changes where necessary?	1	2	g	4	5
1.2		where neededury:	1	2	5	4	5
		Do follow-ups occur to successfully address					
7.3		and resolve documented shortcomings/faults?	1	2	3	4	5
7.4		Were the following Key Quality Check Points identified and implemented in the project:	1	2	3	4	5
	7.4.1	Between planning and design.	1	2	3	4	5
	7.4.2	Between design and development.	1	2	3	4	5
	7.4.3	Between development and verification.	1	2	3	4	5
	7.4.4	Between verification and implementation.	1	2	3	4	5
7.5		Was proof kept of these checks that were performed and accepted by a Quality Forum before the next phase was started?	1	2	3	4	5
7.0		Was a formal acceptance letter generated for each hand-off that was previously established					-
7.6		with entrance criteria?	1	2	3	4	5
	8	Principle 7: Qualified Staff	Strongly Agree	Aaree	Neither agree Nor disagree	Disagree	Strongly Disagree
	-	Are the appointed staff skilled, competent and					
		knowledgeable to resolve and implement next steps and actions relating to the solution					_
8.1		successfully?	1	2	3	4	5
82		Was the handover process utilized/planned to do knowledge transfers from the vendor to those who will support?	1	2	3	4	5
0.2		Did the Quality Assurance team ensure that			5		5
8.3		properly skilled resources were made available to the project?	1	2	3	4	5
0.4		Are continuous resource planning done per				4	
ð.4			1	2	3	4	5
8.5		Was the Business Analyst on the project properly skilled to add the necessary value?	1	2	3	4	5

			1				
86		Was the Project Management on the project	1	2	з	4	5
0.0		Was the Quality Assurance Representative on	1	Ľ	5		
87		the project properly skilled to add the	1	2	3	4	5
0.7					Neither	т Т	J
	9	Principle 8: Clear Accountability	Strongly Agree	Agree	agree Nor disagree	Disagree	Strongly Disagree
9.1		Was the Delegation of authority for the project established in the beginning of the project?	1	2	3	4	5
9.2		Was the Roles & Responsibilities for the project documented?	1	2	3	4	5
9.3		Was the support, maintainability and sustainability planned for the solution?					
9.4		Was an Organisational Chart drawn-up for the project?	1	2	3	4	5
9.5		Was there hand over process used with resource changes?	1	2	3	4	5
		Section	on D				
			-				
		Additional Informatio	on on quality i	mpact			
							1
	10	Quality Assurance Tools and Techniques	Strongly Agree	Agree	Neither agree Nor disagree	Disagree	Strongly Disagree
	10	Quality Assurance Tools and Techniques Was Cost Benefit Analysis performed by the	Strongly Agree	Agree	Neither agree Nor disagree	Disagree	Strongly Disagree
10.1	10	Quality Assurance Tools and Techniques Was Cost Benefit Analysis performed by the Quality Assurance function?	Strongly Agree 1	Agree 2	Neither agree Nor disagree 3	Disagree 4	Strongly Disagree
10.1 10.2	10	Quality Assurance Tools and Techniques Was Cost Benefit Analysis performed by the Quality Assurance function? Were Quality Audits performed by the Quality Assurance function during the project?	Strongly Agree 1	Agree 2	Neither agree Nor disagree 3	Disagree 4	Strongly Disagree 5
<u>10.1</u> 10.2	10	Quality Assurance Tools and TechniquesWas Cost Benefit Analysis performed by the Quality Assurance function?Were Quality Audits performed by the Quality Assurance function during the project?Was a Process Analysis performed by the Quality Approximation operation to available the	Strongly Agree 1	Agree 2 2	Neither agree Nor disagree 3	Disagree 4	Strongly Disagree 5
<u>10.1</u> 10.2	10	Quality Assurance Tools and TechniquesWas Cost Benefit Analysis performed by the Quality Assurance function?Were Quality Audits performed by the Quality Assurance function during the project?Was a Process Analysis performed by the Quality Assurance section to evaluate the current QA process followed and identifying	Strongly Agree 1	Agree 2 2	Neither agree Nor disagree 3	Disagree 4 4	Strongly Disagree 5
10.1 10.2 10.3	10	Quality Assurance Tools and TechniquesWas Cost Benefit Analysis performed by the Quality Assurance function?Were Quality Audits performed by the Quality Assurance function during the project?Was a Process Analysis performed by the Quality Assurance section to evaluate the current QA process followed and identifying areas of improvement?Ware Variance Reports drawn up by the	Strongly Agree 1 1	Agree 2 2 2 2	Neither agree Nor disagree 3 3 3	Disagree 4 4 4	Strongly Disagree 5 5 5
10.1 10.2 10.3	10	Quality Assurance Tools and TechniquesWas Cost Benefit Analysis performed by the Quality Assurance function?Were Quality Audits performed by the Quality Assurance function during the project?Was a Process Analysis performed by the Quality Assurance section to evaluate the current QA process followed and identifying areas of improvement?Were Variance Reports drawn-up by the Quality Assurance function for the project?	Strongly Agree 1 1	Agree 2 2 2 2	Neither agree Nor disagree 3 3 3	Disagree 4 4	Strongly Disagree 5 5 5
10.1 10.2 10.3	10	Quality Assurance Tools and TechniquesWas Cost Benefit Analysis performed by the Quality Assurance function?Were Quality Audits performed by the Quality Assurance function during the project?Was a Process Analysis performed by the Quality Assurance section to evaluate the current QA process followed and identifying areas of improvement?Were Variance Reports drawn-up by the Quality Assurance function for the project?(This can be in the form of Quality Improvement Plans)	Strongly Agree	Agree 2 2 2 2	Neither agree Nor disagree 3 3 3	Disagree 4 4 4	Strongly Disagree 5 5 5
10.1 10.2 10.3 10.4	10	Quality Assurance Tools and TechniquesWas Cost Benefit Analysis performed by the Quality Assurance function?Were Quality Audits performed by the Quality Assurance function during the project?Was a Process Analysis performed by the Quality Assurance section to evaluate the current QA process followed and identifying areas of improvement?Were Variance Reports drawn-up by the Quality Assurance function for the project?Were Variance Reports drawn-up by the Quality Assurance function for the project?Were Variance Reports drawn-up by the Quality Assurance function for the project?Were Execution Checklists compiled by the	Strongly Agree 1 1 1 1 1 1 1 1 1 1	Agree 2 2 2 2	Neither agree Nor disagree 3 3 3 3	Disagree 4 4 4	Strongly Disagree 5 5 5 5
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10.8	Was Documentation Reviews conducted during the project? (This is similar to deliverable reviews, except that it involves reviewing the project documentation produced by the project.)	1	2	3	4	5		
10.0	Was Phase Reviews conducted after each project phase? (This is at the end of each				_			
10.9	be reviewed and is should be determined if the project has met its stated objective.)	1	2	3	4	5		
11	Value Added by the Quality Assurance activities	Strongly Agree	Agree	Neither agree Nor disagree	Disagree	Strongly Disagree		
11.1	Did the Quality Assurance activities within the project assist the project team in achieving the project's goals?	1	2	3	4	5		
11.2	Is there weaknesses in the Quality Assurance activities that you feel should be addressed to add more value to future projects?	1	2	3	4	5		
11.3	Was the system implementation process adopted successful?	1	2	3	4	5		
11.4	Do you feel that the system implementation process would have been successful without the quality assurance activities?	1	2	3	4	5		
The End!								
	Thank you for taking your time in filling this questionnaires.							

APPENDIX B: ETHICS APPROVAL LETTER FROM NMMU



for tomorrow

NORTH CAMPUS FACULTY OF ENGINEERING, THE BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY Tel. +27 (0)41 5043448 Fax. +27 (0)41 5049448 Rushda.Jappie@mmu.ac.za

Student number: 209202620

Ref: H09-Eng-ITe-005

• PO Box 77000 • Nelson Mandela Metropolitan University

• Port Flizebeth • 6031 • South Africa • www.mmmu.ec.ze

3 December 2009

Mr NL Ruxwana PO Box 2461 PRETORIA 0001

Dear Mr Ruxwana

THE ADOPTION OF QUALITY ASSURANCE IN E-HEALTH ACQUISITION FOR RURAL HOSPITALS IN THE EASTERN CAPE PROVINCE

Your above-entitled application for ethics approval served at the Faculty RTI Committee of the Faculty of Engineering, the Built Environment and Information Technology.

We take pleasure in informing you that the application was approved by the Committee.

The Ethics clearance reference number is H09-Eng-ITe-005, and is valid for three years, from 4 November 2009 – 4 November 2011. Please inform the RTI-HDC, via your supervisor, if any changes (particularly in the methodology) occur during this time. An annual affirmation to the effect that the protocols in use are still those for which approval was granted, will be required from you. You will be reminded timeously of this responsibility.

We wish you well with the project.

Yours sincerely

Tim

Rushda Jappie MANAGER: FACULTY ADMINISTRATION

cc: P romoter/Supervisor HoD S chool Representative: Faculty RTI

APPENDIX C: ETHICS APPROVAL LETTER FROM ECDOH

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APPENDIX D: INFORMATION LEAFLET AND INFORMED

CONSENT



FACULTY OF ENGINEERING, THE BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

for tomorrow

SCHOOL OF ICT

INFORMATION LEAFLET AND INFORMED CONSENT

PROJECT TITLE: THE ADOPTION OF QUALITY ASSURANCE IN E-HEALTH ACQUISITION FOR RURAL HOSPITALS IN THE EASTERN CAPE

Primary investigator: Mr Nkqubela Ruxwana, PhD student, NMMU

Study leaders: Prof. Marlien Herselman and Prof. Dalenca Pottas, NMMU

Dear Research participant,

You are invited to participate in a research study that forms part of my formal PhD research study. This information leaflet will help you to decide if you would want to participate in this study. Before you agree to take part, you should fully understand what is involved and what is expected from you as the study participant. You should not agree to take part unless you are completely satisfied with all aspects of the study.

What is the Study All About?

The purpose of this study is to develop a generic Quality Assurance (QA) model for successful acquisition (that is, development and implementation) of e-health solutions (ICT systems to support healthcare service provision and management) in rural hospitals in the Eastern Cape Province for improved quality of care and service delivery. In order to develop this model, this study aims to identify and evaluate the QA methodologies that are currently used in e-health solutions acquisition, to determine the value added by the adopted QA methodologies in ensuring the system acquisition project success, to further determine the methodology shortcomings and challenges experienced in system acquisition, as well as to determine the maturity levels of the processes used for quality management in system acquisition.

The main research objective of this study is to determine how QA methodologies can be used to add value and ensure successful acquisition of e-health solutions for improved quality of care and service delivery in rural

hospitals. In order to achieve this main objective, the following processes will be followed:

- To perform multiple case studies on organisations (companies, department, or project team) that are implementing or have implemented a specific e-health solution in the Eastern Cape, to determine how these organisations make use of the QA methodology in systems implementation.
- To determine if the adopted QA methodology aid the success of the project
- To determine what type of problems the organisations experienced during the implementation of the system and whether better quality assurance measures would have added any value. And,
- To determine the maturity levels of the processes followed in project implementation.

Participant's Role in the Study:

If you decide to take part in the study, you are required to do the following:

- To sign this informed consent form.
- To complete the questionnaires.
- To attend a contact session (informal interviews or presentations) with the researcher, at your premises, to answer some questions after the results of the questionnaires were evaluated.
- To review and suggest amendments of the GQAM
- To test the model, by evaluating its applicability to your organisation, on e-health acquisition.
- Approve the final model; if you are agree with the proposed framework.

Reward/Reimbursement/Expenses for Participation:

There is no financial compensation or reward for participation in this study. However, the benefit is that you will make a contribution towards establishing a GQAM that can be used in future on e-health solution acquisition to ensure better success of projects. This can also help you understand the importance of quality assurance and the role it plays for project success.

Confidentiality/Anonymity and Data Security

Your participation in this study is entirely voluntary. You have the right to withdraw at any stage without any penalty or future disadvantage whatsoever.

Only the researcher and the supervisors will have access to the filled-out questionnaires. Your answers will be totally anonymous and your identity will not be revealed under any circumstance. Also, nobody outside the study panel will be able to connect any answer to you in any recognisable way. The results of this study might be published in a journal and/or presented at meetings, but again without revealing the identity of any research participant. The original questionnaires will be stored in a safe place for five years, after which they will be destroyed.

Results of the Study

As stated above, only the summary of the findings, recommendation and the model will be made available to the participants. The participants will also be involved in refining the model to suit the needs for quality assurance methodology adoption in e-health acquisition projects.

A full academic research thesis, academic conference proceedings, and accredited academic articles will be published with the model details; No participant's details will be included.

Contact Details:

The primary investigator, Mr. Nkqubela Ruxwana, can be contacted during office hours at Tel (012) 680 8072, or on his cellular phone at 082 305 8124, e-mail: Nkqubz@yahoo.co.uk; the study leader, Prof M. Herselman, by e-mail: mherselman@csir.co.za; Prof. D Pottas can be contacted during office hours at Tel (041) 504 3604, or by e-mail: Dalenca.Pottas@nmmu.ac.za

A Final Word

Your co-operation and participation in the study will be greatly appreciated. Please sign the underneath informed consent if you agree to partake in the study. In such a case, you will receive a copy of the signed informed consent from the researcher.

Let's work together, by making this little contribution, to make the Eastern Cape Province a better place!

INFORMED CONSENT

I hereby confirm that I have been adequately informed by the researcher about the nature, conduct, benefits and risks of the study. I have also received, read and understood the above written information. I am aware that the results of the study, including personal details will be anonymously processed into a research report or other research outputs. I understand that my participation is voluntary and that I may, at any stage, without prejudice, withdraw my consent and participation in the study. I had sufficient opportunity to ask questions and of my own free will declare myself prepared to participate in the study.

Research participant's name:		(Please print)
Research participant's contact:		
Research participant's signature:		Date:
Researcher's name:	_ (Please print)	
Researcher's signature:	Date:	

- 1. *Ruxwana, NL, Herselman, ME, Pottas, D and Ouma, S.* 2010. Advocating a quality assurance model for the implementation of e-health solutions in rural South Africa. Health Information Management Journal. Vol 39 No 1
- 2. *Ruxwana, NL, Herselman, ME and Conradie, DP.* 2010. ICT applications as e-health solutions in rural healthcare in the Eastern Cape Province of South Africa. Health Information Management Journal. Vol 39 No 1.
- **3.** *Ruxwana, NL, Herselman, ME & Pottas, D.* 2010. Community awareness and involvement: An overlooked security threat driver. 4th International Symposium on Human Aspects of Information Security & Assurance (HAISA 2010), 17-18 May, Port Elizabeth, South Africa.
- Ruxwana, NL, Niehaus, E, Herselman, M, Grössler, M, D'Souza, P & Ackermann, G. 2010. Resource Management System for Informed Healthcare Decision and Disaster Management. IASTED Health Informatics - AfricaHI 2010 conference 6-8 September 2010 – Gaborone, Botswana conference.
- Ruxwana, NL, Niehaus, E, Herselman, M, Grössler, M, D'Souza, P & Ackermann, G. 2010. Rural Healthcare Resource Optimization through adoption of Spatial Decision Support System alongside with Quality Assurance (submitted to MedInfo conference 2010). 13-15 September 2010, Cape Town.
- 6. *Ouma, S, Ruxwana, NL, Herselman, ME.* An evaluation of e-health initiatives in developing countries; 4th International Conference on Broadband Communication, Information Technology and Biomedical Applications. 15-18 July 2009, Wroclaw, Poland
- **7.** *Ruxwana, N.L.* 2009. Technology Assessment of Rural Hospitals in the Eastern Cape Province (book). Publisher: Vdm Verlag Dr. Müller. ISBN-13: 978-3639125962.